CONNECTICUT COASTAL BASIN

WEST HAVEN, CONNECTICUT

MALTBY LAKE DAM No. 1
CT 00111

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

AUGUST, 1979

UNCLASSIFIED

CURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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Conn. Coastal Basin
West Haven, Conn.
Maltby Lake Dam

ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This 26 ft. high water supply facility dam consists of two main sections. The upstream section is an earthfill dam built in 1862. The downstream part, built in 1900, is a stone masonry gravity section. The area between the two sections was filled in 1900 with a well-compacted clayey soil adjacent to the older upstream fill material. The spillway is a 21.5' ft. long broad-crested stone masonry weir discharging to a concrete and stone channel which leads to a concrete arch culvert under Conn. Route 34 immediately downstream of the dam.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

NOV 28 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Maltby Lake Dam No. 1 Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, New Haven Water Company.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CONNECTICUT COASTAL BASIN

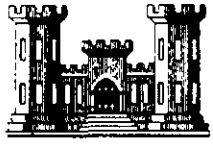
WEST HAVEN, CONNECTICUT

MALTBY LAKE DAM No. 1

CT 00111

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

AUGUST, 1979

BRIEF ASSESSMENT

PHASE IN INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	MALTBY LAKE DAM NO. 1
Inventory Number:	CT-111
State Located:	CONNECTICUT
County Located:	NEW HAVEN
Town Located:	WEST HAVEN
Stream:	TRIBUTARY TO WEST RIVER
Owner:	NEW HAVEN WATER COMPANY
Date of Inspection:	MAY 1, 1979
Inspection Team:	PETER M. HEYNEN
	CALVIN GOLDSMITH
	MIRON PETROVSKY
	GEORGE STEPHENS
	CARL BENKSON

This 26 foot high water supply facility dam consists of two main sections. The upstream section is an earthfill dam built in 1862. The downstream part, built in 1900, is a stone masonry gravity section. The area between the two sections was filled in 1900 with a well-compacted clayey soil adjacent to the older upstream fill material. The spillway is a 21.5' foot long broad-crested stone masonry weir discharging to a concrete and stone channel which leads to a concrete arch culvert under Connecticut Route 34 immediately downstream of the dam. The outlets consist of a 16 inch supply main and a 10 inch low level outlet, both of which are gated on the downstream side of the dam, the 16 inch pipe at a gatehouse at the toe of the dam, and the 10 inch by a gate in a manhole at the toe of the dam. In addition there is a 20 inch pipe through the dam which carries water from the upper Maltby Lake No. 2 to the downstream gatehouse. From the gatehouse, a water line runs to the filtration plant on the opposite side (southeast) of Route 34.

Based upon the visual inspection at the site and past performance, the dam appears to be in good condition. No evidence of instability was observed in the downstream masonry section, the upstream earthfill section, or any appurtenances.

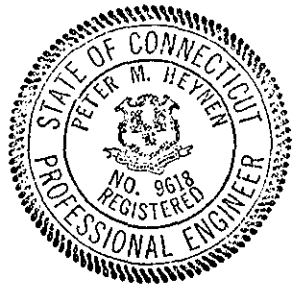
Based upon the size (Small) and hazard classification (High) of the dam in accordance with Corps of Engineers guidelines, the test flood, will be equivalent to one-half the Probable Maximum Flood (PMF). Peak inflow to the reservoir is 1450 cfs; peak outflow is 1220 cfs with the dam overtopped 0.6 feet. Based upon our hydraulic computations, the spillway capacity is 520 cfs without the swale overflow, which is equivalent to 43% of the routed test flood outflow.

It is recommended that the owner initiate further studies to be undertaken to perform a more refined hydraulic/-hydrologic study to determine more accurately the spillway capacity and potential for overtopping. Recommendations should then be made by the engineer and implemented by the owner to increase the project discharge capacity.

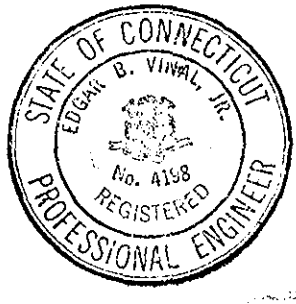
It is further recommended that a registered professional engineer qualified in dam design develop recommendations for the raising of a low swale, located to the right of the dam, to the elevation of the top of the dam.

The above recommendations, and any required remedial measures, are discussed in Section 7, and should be instituted by the owners within two years of their receipt of this report.

Peter M. Heynen, P.E.
Project Manager
Cahn Engineers, Inc.



Edgar B. Vinal Jr., P.E.
Senior Vice President
Cahn Engineers, Inc.



This Phase I Inspection Report on Maltby Lake No. 1 Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam would necessarily represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions there of. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as neccessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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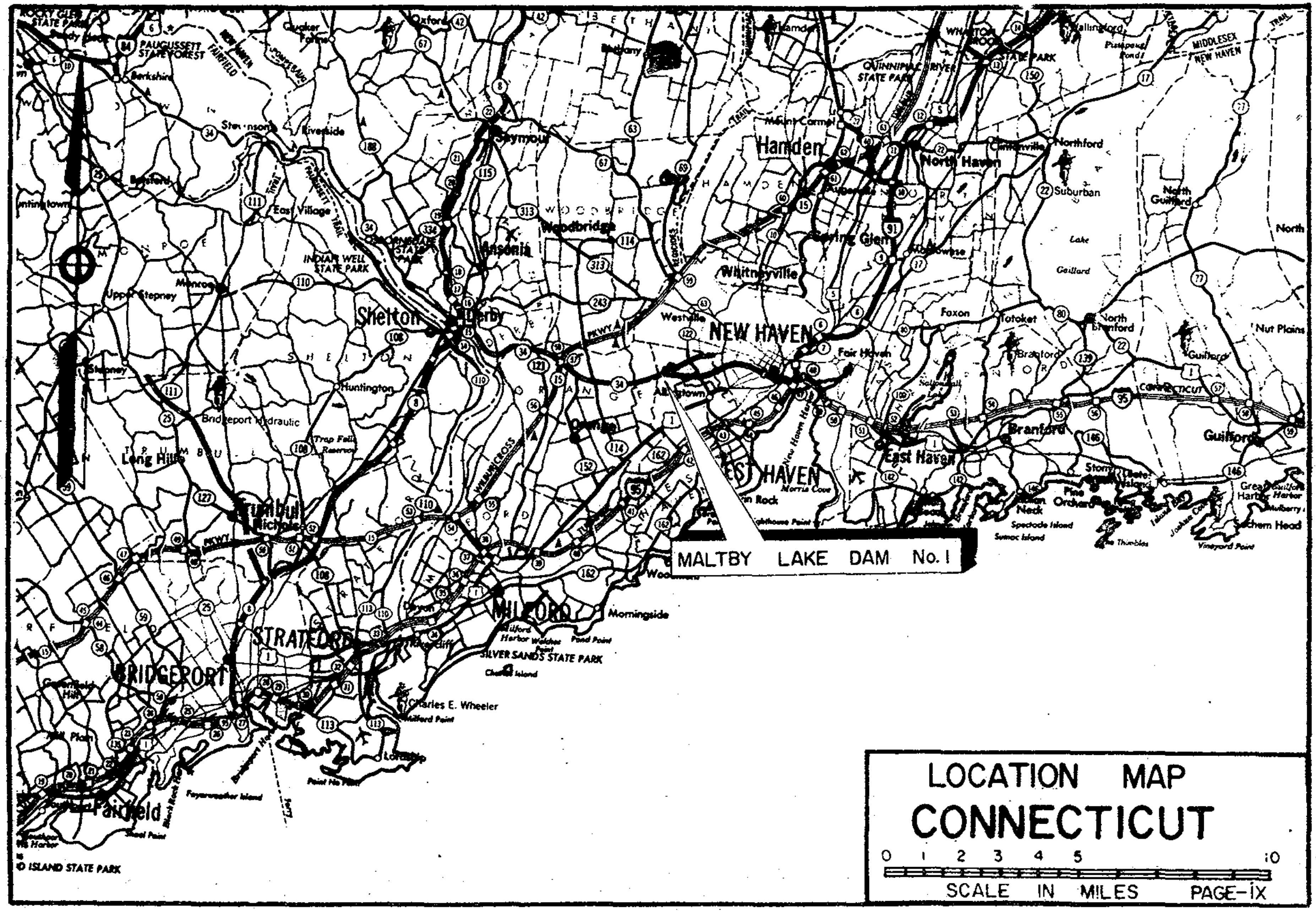
US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	MALTBY LAKE #1 DAM	WEST HAVEN	DATE March '79
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED DAMS	TR.- WEST RIVER	CONNECTICUT	CE # 27 660 KA PAGE viii


MALTBY LAKE DAM No. 1
NEW HAVEN
WEST HAVEN
Hamden
North Haven
East Haven
Branford
Guilford
Woodbridge
Ansonia
Seymour
Shelton
Derby
Orange
MILFORD
STRATFORD
BRIDGEPORT
Fairfield
Trumbull
Long Hill
Whitneyville
Westville
Allingtown
Fair Haven
Foxon
Totoket
North Branford
Northford
Clintonville
Mount Carmel
Bethany
Oxford
Quaker Farms
Berkshire
Stevenson
Riverside
East Village
Upper Stepney
Stepney
Monroe
Huntington
Bridgeport Hydraulic
Nichols
Devon
Morningside
SILVER SANDS STATE PARK
Charles E. Wheeler
Milford Point
Lordship
INDIAN WELL STATE PARK
PAUGUSSETT STATE FOREST
Suburban
North Guilford
Nut Plains
Morris Cove
Pine Orchard
Sachem Head
Lake Gaillard
LOCATION MAP
CONNECTICUT
0 1 2 3 4 5 10
SCALE IN MILES

PHASE I INSPECTION REPORT

MALTBY LAKE DAM NO. 1

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of March 30, 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW 33-79-3-0059 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

3. To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

4. An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgement on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 DESCRIPTION OF THE PROJECT

a. Location - The dam is located on a tributary to the West River (referred to as Silver Brook on Connecticut state highway plans) in an urban area of the Town of West Haven, County of New Haven, State of Connecticut. The dam is shown on the U.S.G.S. New Haven Quandrangle Map as having coordinates latitude N 41° 18.3' and longitude W 72° 58.3'.

b. Description of Dam and Appurtenances - The 182 foot long dam consists of two main sections. The upstream part is an earthfill dam built in 1862 which has a slope of approximately 1.5 horizontal to 1 vertical with riprap on its face. The downstream part, built in 1900, is a sandstone masonry gravity section with an 8 foot wide top and 20 foot wide bottom. The upstream face of the masonry section is vertical, and was covered with cement mortar and two coats of Portland cement grout. The downstream face of the masonry section has an inclination of 1 horizontal to 3 vertical. The space between the two sections was filled with a well compacted clayey earth. The dam is founded on bedrock and has a length of 182 feet from the left abutment to the right edge of the spillway wall. The dam has a height of 26± feet and a top width of 26 to 36 feet. The water level in the lake is maintained by flow from the upper Maltby lakes, which in turn are supplied from the Wepawaug Reservoir, via the Wepawaug Tunnel which flows to Maltby Lake No. 3.

The spillway is a 21.5 foot long stone masonry structure at the right side of the dam. It has a rectangular broad-crested weir with 4 feet of freeboard between its crest and the top of the dam. The spillway bridge has 2.8 feet of clearance from the top of the weir. The spillway discharge channel is a 10 foot wide, 3 foot deep trough with concrete walls having a stone coping. The channel leads to a 10'x5.1' concrete arch culvert which runs under Route 34, immediately downstream of the dam.

The outlets, near the center of the dam, consist of a 16 inch supply main with an intake structure at the upstream toe housing two 12 inch inlets with removable screens. The supply is gated at a downstream gate house, from which water is directed to treatment facilities. Approximately 15 feet to the right of the 16 inch pipe is a 10 inch low level outlet with a gate accessible through a manhole approximately 25 feet from the downstream toe. The 10 inch conduit discharges into the same conduit which carries the spillway discharge. In addition, there is a 20 inch pipe which directs water from the upper Maltby Lakes, under the dam to the downstream gate house. The operator stated that all gates are operable.

c. Size Classification - SMALL - The dam impounds 260 acre-feet of water with the reservoir level at the top of the dam, which at elevation 137.3 MSL is 26 feet above the old streambed. According to the Recommended Guidelines, this dam is classified as small in size.

d. Hazard Classification - HIGH - The dam is located immediately upstream of Connecticut Route 34 and an urbanized commercial and residential section of West Haven near Morris Avenue, Hillside Street, Winfred Street, and Forest Hills Road, which would be in the path of a breach outflow.

e. Ownership - New Haven Water Co.
90 Sargent Drive
New Haven, Ct. 06511
Mr. Jack Reynolds (203) 624-6671

f. Operator - Mr. Carl Benkson
New Haven Water Co.
(203) 387-3930

g. Purpose of Dam - Public water supply.

h. Design and Construction History - The following information is believed to be accurate based on the plans and correspondence available. The original earth dam was built in 1862 and was acquired in 1876 by the New Haven Water Company with the purchase of the Fair Haven Water Company. The masonry section was built in 1900 by the New Haven Water Company, as engineered by Albert B. Hill and constructed by Charles W. Blakeslee and Sons. The discharge culvert under Route 34 was built in 1932 or shortly thereafter, at which time the stone coping was added to the spillway channel walls.

i. Normal Operational Procedures - The gate on the 16 inch supply pipe is operated as needed for water supply purposes. The low level outlet is opened for several hours at least once each year for flushing. Lake level readings are taken daily.

1.3 PERTINENT DATA

a. Drainage Area - 1.3 square miles of rolling, wooded terrain with some residential development.

b. Discharge at Damsite - Discharge is through a 16 inch supply main and a 10 inch low level outlet.

1. Outlet Works (conduits):	16 inch supply main @ invert el. 118.3±
	10 inch low level outlet @ el. 118±
2. Max. known flood @ damsite:	Unknown
3. Ungated spillway capacity @ top of dam el. 137.3:	520 cfs. (does not includes swale overflow)
4. Ungated spillway capacity @ test flood el.:	N/A
5. Gated spillway capacity @ normal pool el.:	N/A
6. Gated spillway capacity @ test flood el.:	N/A
7. Total spillway capacity @ test flood el.:	N/A
8. Total project discharge @ test flood el. 137.9:	1220 cfs.

c. Elevations (Feet Above Mean Sea Level = El. MHW + 3.33')

1. Streambed at centerline of dam:	111.3±
2. Maximum tailwater:	N/A
3. Upstream portal invert diversion tunnel:	165± (Invert of discharge to Maltby Lake No. 3)
4. Recreation pool:	N/A
5. Full flood control pool:	N/A

6. Spillway crest: El. of lowest swale:	133.3 136.4
7. Design surcharge (original design):	N/A
8. Top of dam:	137.3
9. Test flood design surcharge:	137.9

d. Reservoir

1. Length of maximum pool:	2200 ft. (Approx.)
2. Length of recreation pool:	N/A
3. Length of flood control pool:	N/A

e. Storage

1. Recreation pool:	N/A
2. Flood control pool:	N/A
3. Spillway crest pool:	161 acre-ft.
4. Top of dam:	260 acre-ft.
5. Test flood pool:	275± acre-ft.

f. Reservoir Surface

1. Recreation pool:	N/A
2. Flood control pool:	N/A
3. Spillway crest:	22.9 acres
4. Test flood pool:	25+ acres
5. Top of dam:	25 acres

g. Dam

1. Type:	Earthfill with downstream masonry gravity section
2. Length:	182' (left abutment to right spillway wall)

3. Height:	26± ft.
4. Top width:	26 to 36 ft. (Approx)
5. Side slopes:	1.5 H to 1 V (Upstream) 1 H to 3 V (Downstream)
6. Zoning:	Clayey material placed between upstream earth and downstream stone sections
7. Impervious core:	N/A
8. Cutoff:	N/A
9. Grout curtain:	N/A
10. Other:	N/A

h. Diversion and Regulating Tunnel - N/A

i. Spillway

1. Type:	Broad-crested rectangular masonry weir
2. Length of weir:	21.5 ft.
3. Crest elevation:	133.3
4. Gates:	None
5. Upstream channel:	4H to 1V
6. Downstream channel:	10'x3' discharge channel to culvert under Conn. Rte. 34
7. General:	N/A

j. Regulating Outlets

1. Invert:	118.3±
2. Size:	16" and 10" diameter pipes

3. Description:	16" supply main 10" low level outlet
4. Control Mechanism:	Valve at downstream gatehouse (16" pipe) and valve at downstream manhole near toe (10" pipe)
5. Other:	20" pipe under dam to downstream gatehouse from upper Maltby Lakes

SECTION 2: ENGINEERING DATA

2.1 DESIGN

a. Available Data - The available data consists of drawings and records by the State of Connecticut D.E.P., Albert B. Hill, Blair and Marchant, and the New Haven Water Co. (See Appendix B)

b. Design Features - The drawings and records indicate the design features stated previously herein.

c. Design Data - There were no engineering values, assumptions, test results, or calculations available for the 1862 construction of the earth dam or the 1900 construction of the masonry section.

2.2 CONSTRUCTION

a. Available Data - Descriptions are available of the procedure used to build the downstream stone section while incorporating the upstream earth section into the dam. (See Appendix B) No other construction data was obtained.

b. Construction Considerations - As-built drawings are not available.

2.3 OPERATIONS

Lake level readings are taken daily. To our knowledge, the dam spillway capacity has never been exceeded. No other formal operation records are known to exist.

2.4 EVALUATION

a. Availability - Existing data was provided by the Owner and by the State of Connecticut D.E.P. The owner made the facility available for visual inspection.

b. Adequacy - The limited amount of detailed engineering data available was generally inadequate to perform an in-depth assessment of the dam, therefore, the final assessment of this dam must be based primarily on visual inspection, performance history, hydraulic computations and approximate hydrologic judgements.

c. Validity - A comparison of records data and visual observation reveals that the as-built condition of the dam differs from that portrayed on the existing plans of the dam by Albert B. Hill. The major difference appears to be in the configuration of the spillway and the fact that it is 21.5 feet long, rather then 30 feet long as portrayed on the existing plans.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General - The general condition of the dam is good. Inspection did reveal some areas requiring attention. The reservoir level was at elevation 133.4 at the time of our inspection, and the weather was sunny, warm and dry.

b. Dam Crest - The crest of the dam has a grass cover with a service road along its center line (Photo 1). The downstream portion of the crest is an 8 foot wide stone masonry section (Photo 2). No misalignment, depressions or cracks were observed along the dam crest. There was a low swale area on the natural ridge approximately 265 feet to the right of the spillway, which at elevation 136.4, would allow water from the reservoir to overflow 0.9 feet before the lake level reaches the top of the dam.

Upstream Slope - The upstream slope has an inclination of 1.5 horizontal to 1 vertical and is covered with hand placed riprap. No significant loss of riprap or instability was noted during the inspection.

Downstream Slope - The downstream slope of the dam is the rubble masonry gravity section with a downstream face inclination of 1 horizontal to 3 vertical. The vertical upstream face of the masonry section was covered with a cement mortar coating and then had two coats of Portland cement grout brushed on when constructed. The downstream masonry face of the dam has some minor cracks along masonry joints with evidence of lime efflorescence (Photo 2). Some vines were observed on the lower portion of the slope. There are areas of runoff erosion along the toe of the left abutment where there is no erosion protection (Photo 2). The downstream slope of the earth embankment to the right of the spillway is steep and covered with wood chips for erosion protection (Photo 3). It was not apparent whether this area was a portion of the dam, and it showed no signs of erosion or instability.

Spillway - The 21.5 foot long spillway is a stone masonry broad-crested rectangular weir with 4 feet of freeboard between its crest and the top of the dam. The spillway is spanned by a bridge which has a 2.8 foot high clearance from the top of the weir (Photo 3). The spillway is generally in good condition. Some minor deterioration was observed on the downstream wingwalls. The dam operator said there are several seepage spots on the spillway face which can be seen during the dry season. Some leakage at the spillway base was noted also by maintenance personnel in May, 1964 according to existing correspondence. During a preliminary inspection performed on April 17, 1979, at a time when water was not flowing over the spillway, we observed seepage in two

places immediately adjacent downstream of the weir. Seepage was emanating from the right training wall at the bedrock interface, and on the left training wall from the mortar joints between two stone blocks. Seepage flow observed was minor, but steady.

c. Appurtenant Structures - The concrete chamber of the upper gatehouse has no signs of visible cracks or spalling (Photo 1). No substantial rusting was observed on the metal service bridge.

The spillway discharge channel is a 10 foot wide and 3 foot deep open trough with concrete stone coping walls, and leads to a concrete arch culvert under Connecticut Route 34 immediately downstream. Some cracking and spalling of the concrete was observed at the left wall of the channel (Photo 4).

d. Reservoir Area - The reservoir area is bordered on the southeast by Route No. 34, with the exception of a small portion of the lake about 1/2 mile west along Route 34 from the dam. This small portion is on the south side of Route 34 and is joined to the main portion of Maltby Lake No. 1 by a conduit through the roadway embankment. The area directly surrounding the reservoir is wooded and predominantly undeveloped.

e. Downstream Channel - The downstream channel is the natural streambed on the other (southeast) side of Route 34 which flows for a short distance through an urban area of West Haven before being carried within the storm drainage system of West Haven.

The Route 34 roadway immediately downstream of the dam is at the same approximate elevation as the top of the upstream headwall for the spillway discharge conduit under the road. Therefore, when spillway flow exceeds the conduit capacity, water will flow over the roadway with no significant attenuating affect due to the roadway itself.

3.2 Evaluation

Based upon the visual inspection, it was possible to assess the dam as being generally in good condition. The following features which could influence the future condition and/or stability of the dam were identified.

1. The deteriorated masonry and concrete surfaces of the spillway and the spillway discharge channel should be repaired to prevent their further deterioration.

2. The seepage from the spillway face and spillway channel walls should be monitored periodically for any change in the condition.

3. Vegetation, such as vines, at the downstream slope of the masonry section should be removed to avoid deterioration of the masonry.

4. Surface erosion along the downstream face of the left abutment should be repaired to prevent further, more serious erosion.

5. With the low level outlet pipes gated on the downstream side of the dam, the conduits through the dam are under constant head. This situation is not desireable, and in the future should repair or redesign of the hydraulic facilities take place, consideration should be given to the installation of gates on the upstream side of the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Regulating procedures

Operating procedures consist of regulating the flow through the 16 inch main supply line as necessary for water supply purposes. The low level outlet is opened for several hours once per year for flushing. The level of all three Maltby Lakes is maintained by regulating flow into Maltby Lake No. 3 via the Wepawaug Tunnel, from Wepawaug Reservoir. Lake level readings are taken daily.

4.2 Maintenance of the Dam

Grass on and around the dam is cut regularly. Debris is removed from the spillway channel and intake screeens are cleaned as needed.

Three years ago the New Haven Water Company instituted a yearly program of inspection of all their dams including Maltby Lake Dam No. 1, by a consultant competent in the field of dam inspections.

4.3 Maintenance of Operating Facilities

Gate operating mechanisms are maintained on an as-needed basis. The low level outlet is opened once per year for several hours for flushing.

4.4 Description of any Formal Warning System in Effect

No formal warning system is in effect. The operator reports any emergencies to his supervisor.

4.5 Evaluation

The operation and maintenance procedures are generally good; however, there are some areas requiring improvement. A formal program of operations and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal warning system should be developed and implemented within the time frame indicated in Section 7.1c. Remedial operations and maintenance recommendations are presented in Section 7.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General - The Maltby Lake No. 1 watershed includes the drainage areas of Maltby Lakes No. 2 and 3 located immediately upstream, and the tunnel diversion to Maltby Lake No. 3 from Wepawaug and Trout Brooks. As reported by the New Haven Water Company, the diversion from Wepawaug Reservoir is gated at the tunnel inlet. The diversion from Trout Brook is gated at its junction with the Wepawaug Tunnel. As both diversions are controlled and could be closed to Maltby Lake No. 3 as part of the emergency operational procedures, flow from these diversions will not be considered in our hydraulic/hydrologic analysis of Maltby Lake Dam No. 1.

The peak inflow to Maltby Lake No. 1 is regulated by Maltby Lake Dams No. 2 and 3. Approximate routing of the Probable Maximum Flood (PMF) and the 1/2 PMF peak inflows has demonstrated that the regulating effect on the peak inflow of the two upstream Maltby Lakes is relatively small and, therefore, it will not be considered in the analysis.

The terrain to the right of the dam rises and falls along a natural ridge forming a series of swales, one of which, located 265 feet to the right of the spillway, may be low enough to allow water from the reservoir to overflow at an elevation up to 0.9 feet below the top of the dam elevation (See Appendix D-7). Spillway capacity for this dam was determined both with and without overflow through the swale; the case considered appropriate for this dam will not include overflow from the swale, as it is a condition which should be corrected.

b. Design Data - No hydraulic/hydrologic design data could be found for the original dam construction in 1862 or for the construction of the dam to its present configuration in 1900.

c. Experience Data - No information on serious problem situations arising at the dam was found, and it does not appear the dam has been overtopped.

d. Visual Observations - The wooden bridge spanning the spillway is supported by four steel beams which are approximately 2.8 feet above the spillway crest, and 1.2 feet below the top of the dam. During heavy flows approaching the top of the dam, the low bridge beams could retain large floating debris and cause an obstruction of the spillway.

The bar screen over the entrance to the spillway discharge culvert immediately downstream of the dam also could easily retain debris and obstruct the flow to the culvert. While this would back up flow at the toe of the dam, its effect on the stability of the dam or the flow over the spillway would be negligible.

e. Test Flood Analysis - The test flood for this high hazard, small size dam is equivalent to the Probable Maximum Flood (PMF). Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge," dated March, 1978, peak inflow to the reservoir is 1450 cfs (Appendix D-5); peak outflow is 1220 cfs with the dam overtopped 0.6 feet (Appendix D-13). Based upon our hydraulic computations, the spillway capacity is 520 cfs (not including overflow from a natural swale about 265 feet to the right of the spillway) which is approximately 43% of the routed Test Flood outflow. The spillway capacity including the swale overflow would be 590 cfs, or approximately 48% of the routed Test Flood outflow.

f. Dam Failure Analysis - Utilizing the April 1978 "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", the peak failure outflow from the dam breaching would be 14,100 cfs. A breach of the dam would result in a flood depth of 11 feet immediately downstream of the dam which would submerge the adjacent portion of Route 34, and a flood depth outside the stream channel of 4 feet above the ground at the initial impact area (See Appendix D-16), which is an urbanized section of West Haven near Morris Avenue, Hillside Street, Winfred Street, and Forest Hills Road.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation - The visual inspection did not reveal any indications of stability problems. There are some areas of cracking, spalling and seepage at the gravity masonry section of the dam spillway and spillway discharge channel, as described in Section 3, however they are not considered stability concerns.

b. Design and Construction Data - The limited amount of design and construction data is not sufficient to permit an in-depth analysis of the stability of the dam.

c. Operating Records - The operating records do not include any indication of dam instability since its construction in 1900 or since subsequent modifications have been performed.

d. Post-Construction Changes - There are no records available concerning the post-construction changes of the dam. However, there are two drawings showing that the stone coping of the spillway channel walls and modification of the culvert under the Route 34 were implemented in 1932. These changes have no effect on the stability of the dam.

e. Seismic Stability - The dam is in Seismic Zone 1 and according to the Recommended Guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - Based upon the visual inspection of the site and its past performance, the dam appears to be in good condition. No evidence of structural instability was observed in the dam and its appurtenances. The embankment is generally in good condition. There are some areas requiring attention, such as project discharge capacity and maintenance items.

Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge" dated March, 1978, peak inflow to the reservoir is 1450 cubic feet per second; peak outflow is 1220 cubic feet per second with the dam overtopped 0.6 feet. Based upon our hydraulics computations, the spillway capacity is 520 cubic feet per second, (not including the swale overflow) which is equivalent to approximately 43% of the routed Test Flood outflow.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the dam must be based solely on visual inspection, past performance of the dam, and sound engineering judgement.

c. Urgency - It is recommended that the measures presented in Section 7.2 and 7.3 be implemented with two years of the owner's receipt of this report.

d. Need for Additional Information - There is a need for more information as recommended in Section 7.2.

7.2 Recommendations

1. Based upon the computations in Appendix D, the dam spillway capacity will be exceeded by the Test Flood. More sophisticated flood routing should be undertaken by hydrologists/hydraulics engineers to refine the spillway design flood figures. A study should be undertaken to determine the spillway capacity and potential for overtopping. Recommendations should be made by the engineer and implemented by the owner to increase the project discharge capacity based upon the refined spillway design flood figures.

2. A registered professional engineer qualified in dam design should develop recommendations to raise the elevation of the swale, located 265 feet to the right of the spillway to the elevation of the top of the dam. This would prevent flow from the swale under high water conditions, which would cross Route 34 and cause flooding in the urbanized area of West Haven immediately downstream.

7.3 Remedial Measures

a. Operation and Maintenance Procedures - The following measures should be undertaken within the time frame indicated in Section 7.1c, and continued on a regular basis.

1. Round-the-clock surveillance should be provided by the owner during periods of unusually heavy precipitation. The owner should develop a formal warning system with local officials for alerting downstream residents in case of an emergency.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

3. The New Haven Water Company has instituted a yearly program of technical inspection of all their dams, including Maltby Lake No. 1, by a consultant competent in the field of dam inspection. This program, in effect for 3 years, should be continued and should include the operation of the low level outlet works.

4. The cracking and spalling of the concrete and masonry of the gravity section of the dam, the downstream face of the spillway and the spillway diversion channel walls should be repaired.

5. Any seepage on the downstream face or training walls of the spillway and its channel walls should be monitored periodically.

6. The cutting of grass on the crest and the toe of the dam should be continued as part of the routine dam maintenance. Any vegetation on the downstream face of the masonry section of the dam should be removed.

7. Erosion of the downstream face of the left abutment should be repaired, and the appropriate measures taken to prevent further erosion.

8. The diversions into Maltby Lake No. 3 from Wepawaug Reservoir and Trout Brook should be closed during major storms as part of the emergency operating procedures for the Maltby Lake Dams.

7.4 Alternatives

This study has identified no practical alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT MALTBY LAKE DAM NO.1 DATE: MAY 1, 1978

TIME:

WEATHER: SUNNY, 70°

W.S. ELEV. ____ U.S. — DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. PETER M. HEYNEN	PMH	CAHN ENGINEERS, INC.
2. CALVIN R. GOLDSMITH	CRG	" " "
3. MIRON PETROVSKY	MP	" " "
4. GEORGE STEPHENS	GS	" " "
5. CARL BENGSTON	CB	NEW HAVEN WATER CO.
6.		

PROJECT FEATURE	INSPECTED BY	REMARKS
1. EARTH DAM EMBANKMENT	PMH, CRG, MP, GS, CB	
2. SPILLWAY AND CHANNELS	" " " " "	
3. UPPER AND LOWER GATE HOUSES	" " " " "	
4. METAL SERVICE BRIDGE	" " " " "	
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

PERIODIC INSPECTION CHECK LIST

PROJECT MALTBY LAKE DAM No.1 DATE MAY 1, 1979

PROJECT FEATURE EARTHFILL DAM WITH DOWNSTREAM MASONRY GRAVITY SECTION BY PMH, CRG, MPGS, CR

AREA EVALUATED		CONDITION
M EMBANKMENT		
rest Elevation		137.3±
ırrent Pool Elevation		
aximum Impoundment to Date		N/A
ırface Cracks		NONE OBSERVED
avement Condition		N/A
ovement or Settlement of Crest		NONE OBSERVED
ateral Movement		NONE OBSERVED
ertical Alignment		NONE OBSERVED
orizontal Alignment		NONE OBSERVED
ondition at Abutment and at Concrete tructures		GOOD
ndications of Movement of Structural tems on Slopes		NONE OBSERVED
respassing on Slopes		NONE
loughing or Erosion of Slopes or butments		NONE OBSERVED
ock Slope Protection-Riprap Failures		NONE OBSERVED
nusual Movement or Cracking at or ear Toes		NONE OBSERVED
nusual Embankment or Downstream eepage		NONE OBSERVED
iping or Boils		NONE OBSERVED
oundation Drainage Features		N/A
oe Drains		N/A
nstrumentation System		N/A

PERIODIC INSPECTION CHECK LIST

PROJECT MALTBY LAKE DAM No. 1 DATE MAY 6 1979

PROJECT FEATURE UPPER GATEHOUSE BY PMH, CRG, MP, GS, CB

AREA EVALUATED	CONDITION
OUTLET WORKS-CONTROL TOWER	BRICK STRUCTURE ON CONCRETE CHAMBER
a) Concrete and Structural	
General Condition	GOOD
Condition of Joints	NONE OBSERVED
Spalling	NONE OBSERVED
Visible Reinforcing	NONE OBSERVED
Rusting or Staining of Concrete	NONE OBSERVED
Any Seepage or Efflorescence	NONE OBSERVED
Joint Alignment	NONE OBSERVED
Unusual Seepage or Leaks in Gate Chamber	NOT OBSERVED
Cracks	NONE OBSERVED
Rusting or Corrosion of Steel	NOT OBSERVED
b) Mechanical and Electrical	NOT OBSERVED
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECK LIST

PROJECT MALTBY LAKE DAM No.1 DATE MAY 1, 1979

PROJECT FEATURE LOW LEVEL PIPES BY PMH, CRG, MP, GS, CB

AREA EVALUATED		CONDITION
TLET WORKS-TRANSITION AND CONDUIT		Two 16" and 10" DIAMETER METAL PIPES THROUGH DAM. NOT ABLE TO OBSERVE CONDUITS, HOWEVER, THE OPERATOR SAID THAT ALL CONDUITS ARE OPERABLE BY GATES AT D/S GATEHOUSE (16" PIPE) AND TOE MANHOLE (10" PIPE)
neral Condition of Concrete		
st or Staining on Concrete		
alling		
osion or Cavitation		
acking		
ignment of Monoliths		
ignment of Joints		
mbering of Monoliths		

PERIODIC INSPECTION CHECK LIST

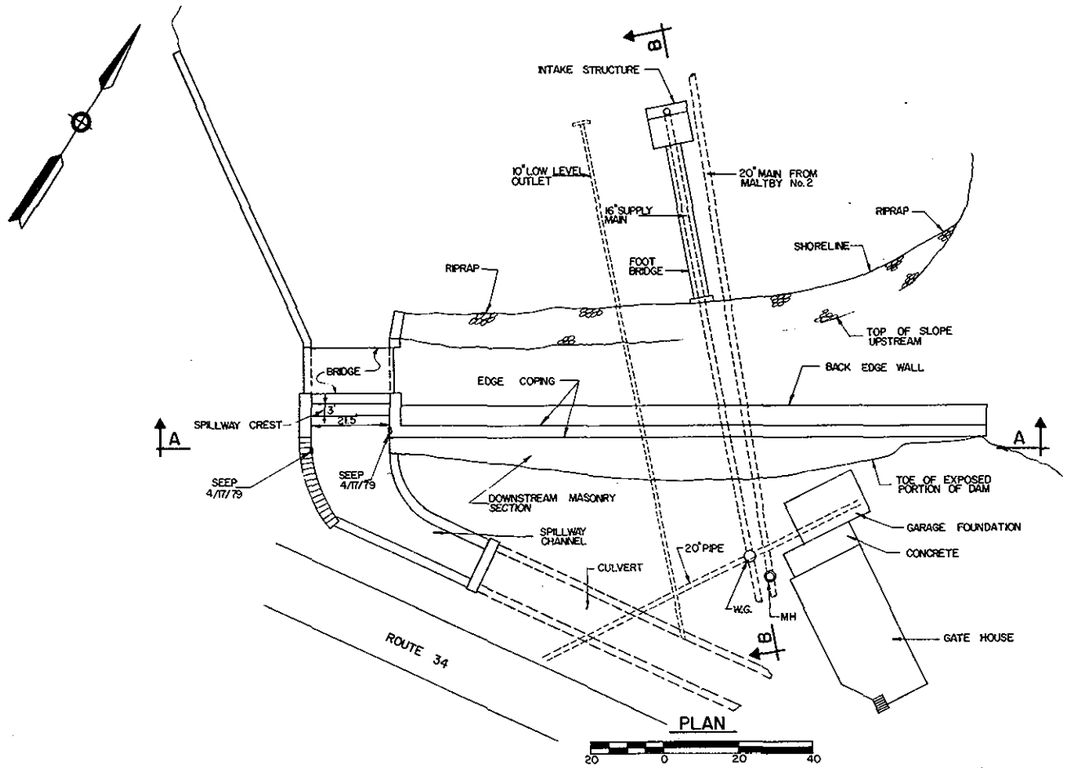
PROJECT MALTBY LAKE DAM NO.1 DATE MAY 1, 1979

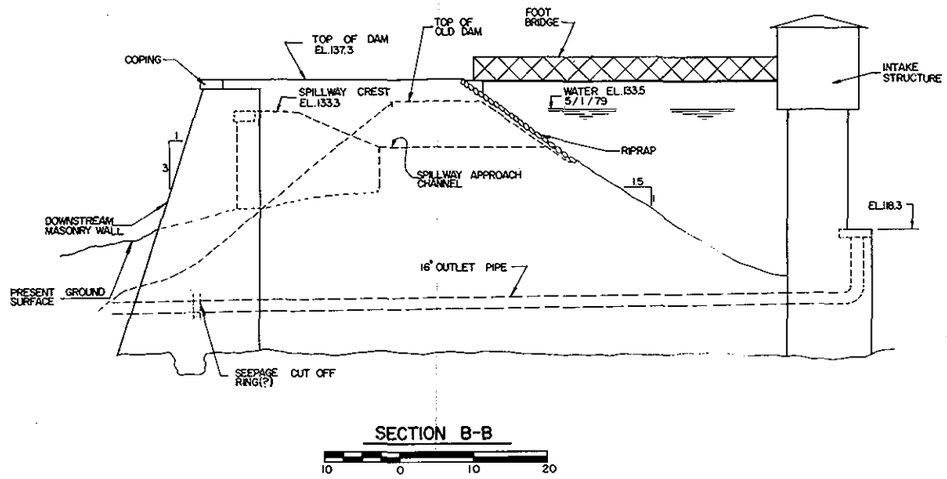
PROJECT FEATURE SPILLWAY AND CHANNELS BY PMH, CRG, MPGS, CB

AREA EVALUATED		CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		
a) Approach Channel		STONE MASONRY CHANNEL
General Condition		GOOD
Loose Rock Overhanging Channel		NONE
Trees Overhanging Channel		NONE
Floor of Approach Channel		NOT OBSERVED (UNDER WATER)
b) Weir and Training Walls		STONE MASONRY SPILLWAY
General Condition of Concrete		GOOD
Rust or Staining		NOT OBSERVED
Spalling		MINOR DISTRESSES OF TRAINING WALLS
Any Visible Reinforcing		NONE
Any Seepage of Efflorescence		MINOR SEEPAGE FROM RIGHT TRAINING WALL AT BEDROCK INTERFACE
Drain Holes		N/A
c) Discharge Channel		CONCRETE WALL TRAY
General Condition		GOOD, SOME SPALLING AT LEFT WALL
Loose Rock Overhanging Channel		NONE
Trees Overhanging Channel		NONE
Floor of Channel		GOOD, HAND PLACED STONE
Other Obstructions		NONE

APPENDIX B

ENGINEERING DATA AND CORRESPONDENCE





SECTION B-B

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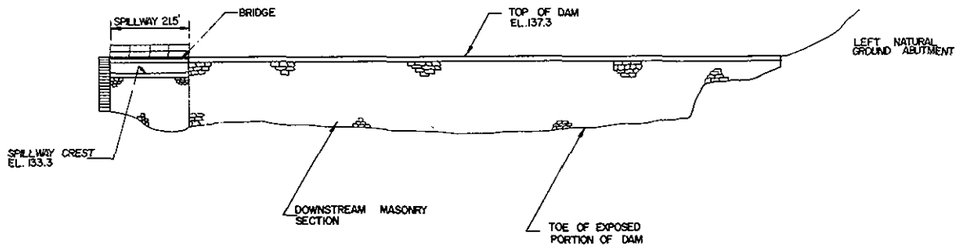


ELEVATION A-A (H&V)

20 0 20 40

3. THIS PLAN WAS COMPILED FROM EXISTING PLANS ENTITLED "PLAN FOR REBUILDING MALTBY DAM NO.1" BY ALBERT HILL, CULVERT FOR SPILLWAY CHANNEL MALTBY LAKE NO.1 BY BLAIR & MARCHANT DATED MARCH 1932, TWO UNTITLED AND UNDATED PLANS AND FROM ROUGH FIELD MEASUREMENTS. DIMENSIONS SHOWN ARE APPROXIMATE AND NOT ALL STRUCTURAL AND/OR TOPOGRAPHIC FEATURES ARE IDENTIFIED.

2. ELEVATIONS SHOWN ARE BASED ON THE MEAN SEA LEVEL DATUM. ELEVATIONS SHOWN WERE CONVERTED FROM THE MEAN HIGH WATER DATUM SHOWN ON THE ORIGINAL PLANS, WHICH IS APPROXIMATELY 3.3 FEET ABOVE THE MEAN SEA LEVEL DATUM.

CAHN ENGINEERS INC. WALLINGFORD, CONNECTICUT ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PLAN, ELEVATION AND SECTION

MALTBY LAKE DAM No.1

TR—WEST RIVER — WEST HAVEN, CONNECTICUT

DRAWN BY	CHECKED BY	APPROVED BY	SCALE: AS NOTED	
M. N.	JAC	PMH	DATE: JUNE 1979	SHEET 8-1

LIST OF EXISTING PLANS

"New Haven Water Co., Plan for Rebuilding Maltby No. 1 Dam."
Albert B. Hill, Consulting Engineer
1901

"New Haven Water Co., Culvert for Spillway Channel, Maltby Lake No. 1."
Blair and Marchant, Inc.
March, 1932

"New Haven Water Co. Spillway Channel - Maltby Lake No. 1, Plan of Sandstone Coping"
Blair and Marchant, Inc.
June, 1932

"New Haven Water Co., Contour Map, Area North of Maltby Lake No. 1"
April, 1941, rev. March, 1946

SUMMARY OF DATA AND CORRESPONDENCE

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

Inventoried By WPS

Date 21 MAY 1964

Name of Dam or Pond MALTBY LAKES (LOWER)

Code No. WS 2 8 01.2

Nearest Street Location ROUTE 34

Town WEST HAVEN

U.S.G.S. Quad. NEW HAVEN

Name of Stream UNNAMED

Owner NEW HAVEN WATER COMPANY

Address 100 CROWN STREET
NEW HAVEN

Pond Use(s) WATER SUPPLY

Dimensions of Pond: Width 400 FEET Length 2000 FEET Area 20 ACRES

Total Length of Dam 135 FEET Length of Spillway 20 FEET

Location of Spillway SOUTH-WEST END OF DAM

Height of Pond Above Stream Bed 25 FEET

Height of Embankment Above Spillway 5 FEET

Type of Spillway Construction MASONRY

Type of Dike Construction MASONRY, EARTH UPSTREAM

Downstream Conditions CULVERT UNDER ROUTE 34

Summary of File Data

Remarks SOME LEAKAGE NOTED AT BASE OF SPILLWAY

Would Failure Cause Damage? YES Class B

NEW HAVEN WATER COMPANY

NAME OF DAM Maltby Dam No. 1

TYPE A gravity section, masonry dam of rubble masonry with cut stone facing with an upstream earth embankment and gate-house at toe of the embankment reached by a steel bridge. A cement mortar coating was placed on the upstream face of this masonry section. Two good coats of Portland cement grout were brushed on the mortar coating.

LOCATION In West Haven, Connecticut on the north side of Derby Avenue (State Highway No. 34) and approximately 3,200 feet east of the Orange-West Haven town line.

SUPPLY SYSTEM Maltby

DATE OF CONSTRUCTION

ORIGINAL 1900

OTHER This dam replaced a smaller, lower dam of earth built in 1862 which was acquired in 1876 by purchase of the Fair Haven Water Company. Somewhat upstream from the new masonry constructed in 1900, it was incorporated within the upstream embankment of the dam built in 1900 by N. H. Water Co. The space between the upstream face of the gravity masonry section and the downstream slope of this old 1862 earth dam was filled with "clayey earth, bonded into the old material, and thoroughly rammed."

ENGINEER	CONTRACTOR
1900 - Albert B. Hill	Charles W. Blakeslee & Sons

	Elevation	Length (Ft.)	Miscellaneous
CREST	134 MHW	±240	Includes spillway
SPILLWAY	130 MHW	30	
AXIS OF ~~B.-O.~~	115 MHW	Axis of lowest intake	
BED OF RIVER	±108 MHW	-	
DEEPEST FOUNDATION	±97 MHW	-	

DATE August 1974

NEW HAVEN WATER COMPANY

Name of Dam Maltby Dam No. 1

HEIGHT FROM BED OF BROOK		26 feet
HEIGHT FROM DEEPEST FOUNDATION		37 feet
TOP WIDTH	Masonry section	8 feet
MAXIMUM WIDTH AT BOTTOM	Masonry section	20 feet
UPSTREAM SLOPE	Masonry section	Vertical
DOWNSTREAM SLOPE	Masonry section	4 Hor. on 12 Ver.
FREE BOARD - SPILLWAY TO CREST		4 feet
- SPILLWAY TO TOP OF COREWALL		-

MISCELLANEOUS DATA Masonry section founded on ledge rock. Studies and borings have been made for a proposed reservoir north of Route No. 34 (Derby Avenue) on Race Brook which would flow into the Wepawaug Tunnel which flows to the Maltby Lakes.

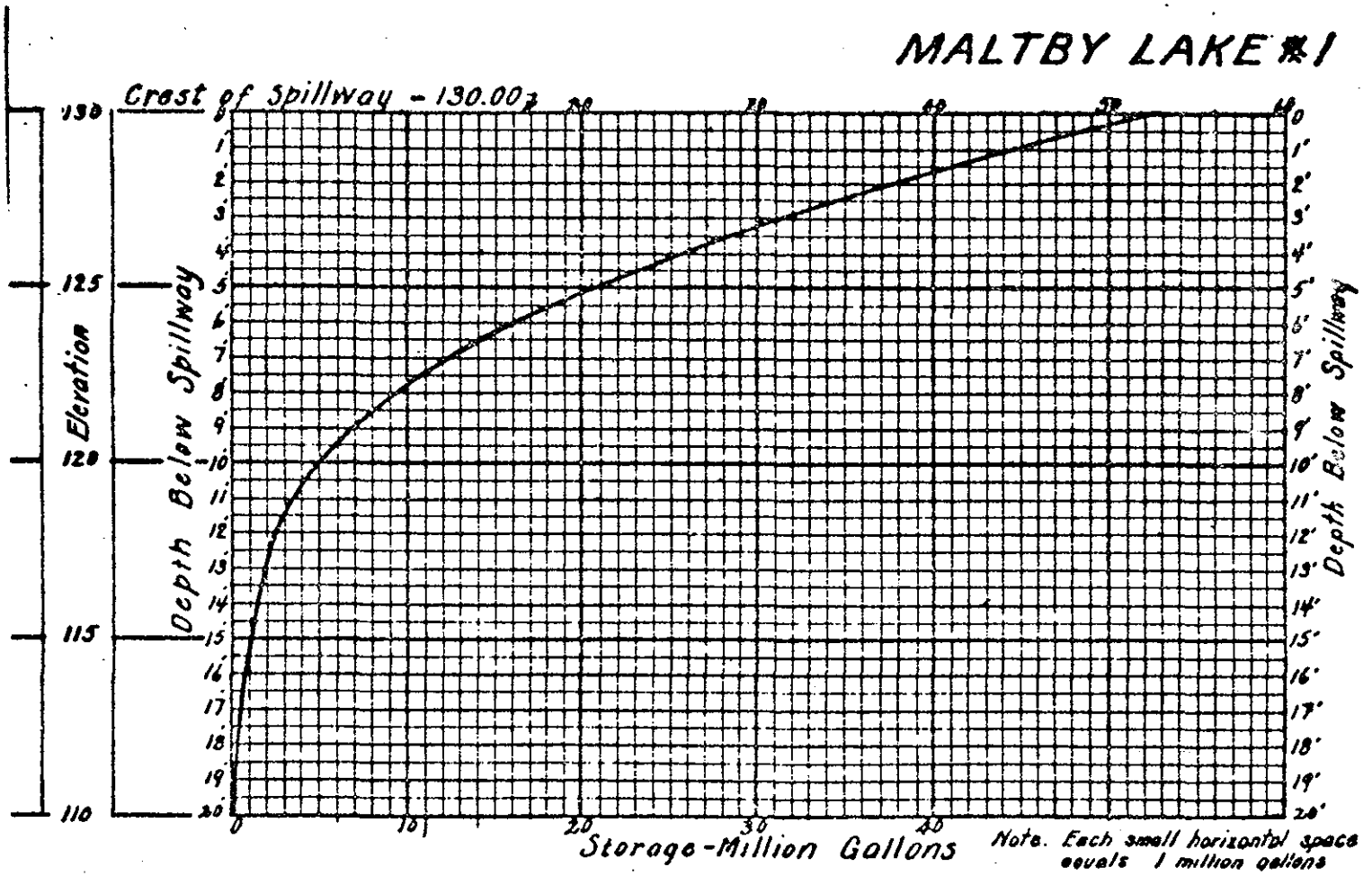
WATERSHED TRIBUTARY TO:

UPSTREAM DAMS	Wepawaug 7.8 Trout Brook Div. 0.8=	8.6 Sq. Mi.
THIS DAM Includes watersheds of Maltby No.2&3		1.2 Sq. Mi.
TOTAL WATERSHED TRIBUTARY TO THIS DAM		9.8 Sq. Mi.
RESERVOIR AREA AT FLOW LINE		22.9 Acres
RESERVOIR CAPACITY AT FLOW LINE		-
RESERVOIR USABLE CAPACITY (To Lowest Outlet)		51 Mil. Gal.

154,5ac.-ft

UPSTREAM DAMS Wepawaug Dam; Trout Brook Diversion (these flow to Maltby Reservoir No. 3 via the Wepawaug Tunnel); Maltby Dam No. 2; and Maltby Dam No. 3.

DOWNSTREAM DAMS None


MALTBY LAKE #1
Crest of Spillway - 130.00'
Elevation
130
125
120
115
110
Depth Below Spillway
0
1'
2'
3'
4'
5'
6'
7'
8'
9'
10'
11'
12'
13'
14'
15'
16'
17'
18'
19'
20'
0
10
20
30
40
Storage-Million Gallons
Note. Each small horizontal space equals 1 million gallons

APPENDIX C

DETAIL PHOTOGRAPHS

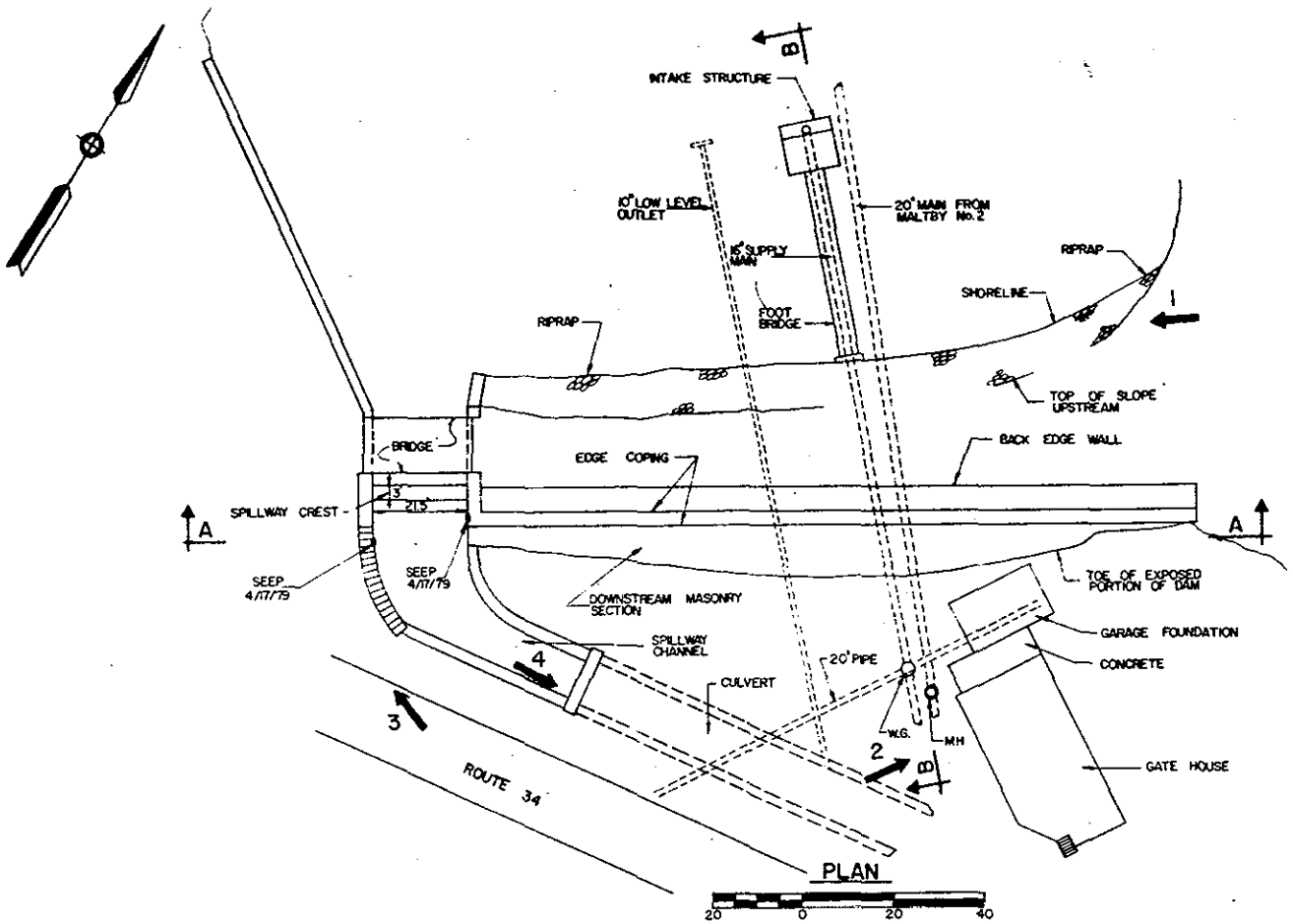


PHOTO LOCATION PLAN

MALTBY LAKE DAM No.1

SHEET C-1

PHOTO 1 - Upstream face of dam as seen from left abutment.
Note intake structure and metal service bridge.

PHOTO 2 - Left abutment and downstream face of dam.
Note efflorescence from stone block masonry.

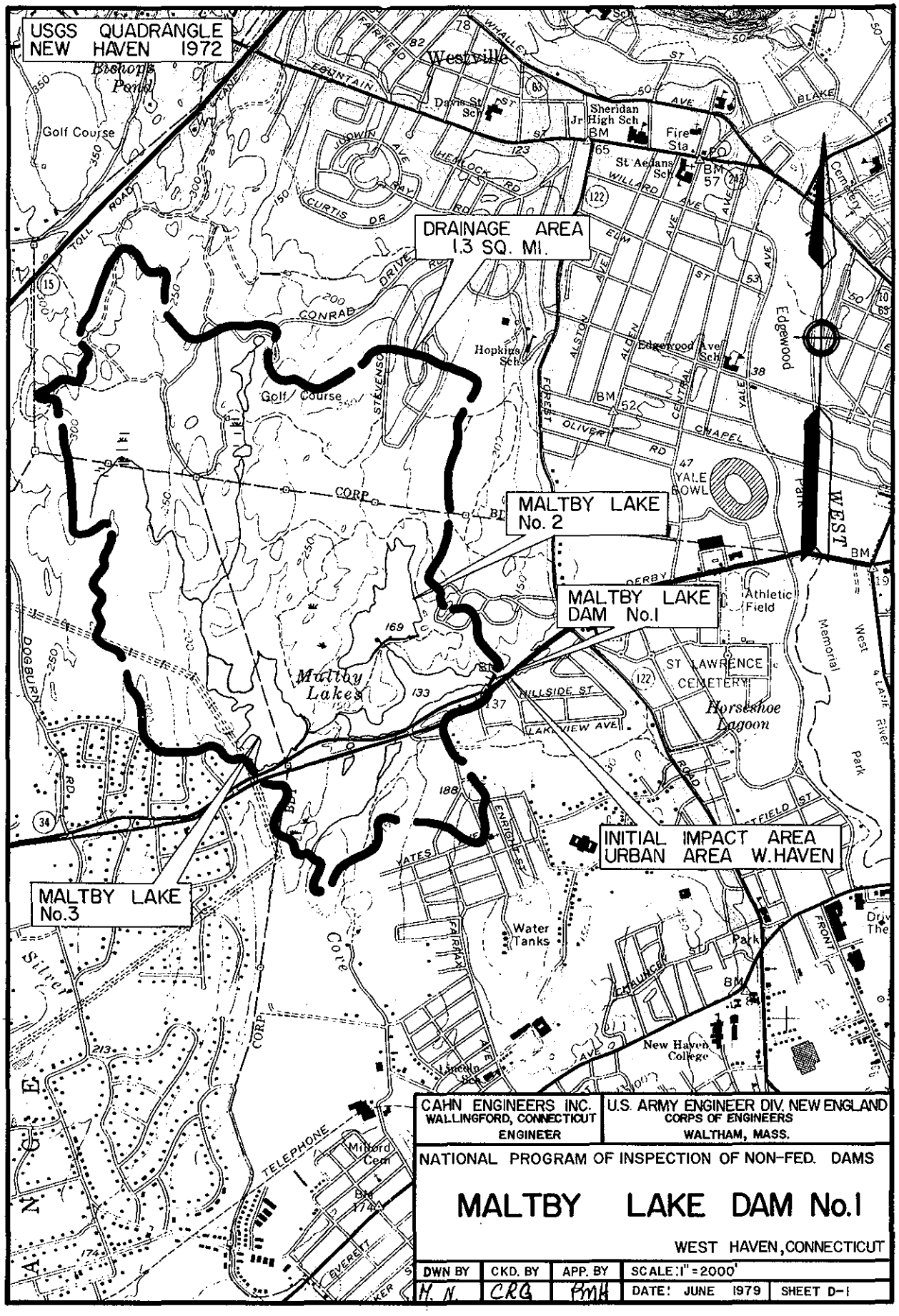
US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Maltby Lake #1 Dam Tr - West River West Haven, Connecticut
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED. DAMS	CE# 27 660 KA DATE May '79 PAGE C-1

PHOTO 3 - Right abutment and spillway crest.

PHOTO 4 - Entrance to culvert under road located near toe of dam. Note cracking and spalling of sides of concrete spillway channel.

APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS


USGS QUADRANGLE
NEW HAVEN 1972
DRAINAGE AREA
1.3 SQ. MI.
MALTBY LAKE
No. 2
MALTBY LAKE
DAM No.1
MALTBY LAKE
No.3
INITIAL IMPACT AREA
URBAN AREA W.HAVEN
Maltby Lakes
Horseshoe Lagoon
Bishops Pond
Golf Course
Westville
Sheridan High Sch
Hopkins Sch
Edgewood Ave Sch
St Aedans Sch
Fire Sta
P.O.
Cemetery
YALE BOWL
Athletic Field
ST LAWRENCE CEMETERY
Water Tanks
New Haven College
Lincoln Sch
Milford Cem
Silver
Core
CAHN ENGINEERS INC.
WALLINGFORD, CONNECTICUT
ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
MALTBY LAKE DAM No.1
WEST HAVEN, CONNECTICUT
DWN BY
CKD. BY
APP. BY
SCALE: 1" = 2000'
H. N.
CRG
PMH
DATE: JUNE 1979
SHEET D-1

HYDROLOGIC / HYDRAULIC INSPECTION

MALTBY LAKE DAM #1, WEST HAVEN, CT.

I) PERFORMANCE AT TEST FLOOD CONDITIONS

1) MAXIMUM PROBABLE FLOOD

a) WATERSHED CLASSIFIED AS "ROLLING" TO "FLAT"

b) WATERSHED AREA

THE MALTBY LAKE #1 WATERSED INCLUDES THE DRAINAGE AREAS OF MALTBY LAKES #2 AND #3, WHICH ARE LOCATED JUST IMMEDIATELY U/S, AND THE TUNNEL DIVERSION TO MALTBY LAKE #3 FROM THE WEPAWAUG AND TROUT BROOKS.

THE DIVERSION FROM WEPAWAUG RESERVOIR IS CONTROLLED* (GATED) AT THE TUNNEL INLET AND THEREFORE IT CAN BE CLOSED TO MALTBY #3 AS A PART OF THE OPERATIONAL PROCEDURES OF AN EMERGENCY WARNING SYSTEM. THEREFORE, FLOW FROM THIS CONTROLLED DIVERSION WILL NOT BE CONSIDERED IN THIS ANALYSIS.

THE DIVERSION FROM TROUT BROOK ALSO IS GATED AT ITS JUNCTION WITH THE WEPAWAUG TUNNEL (N.N.W.C. DWG. NO. 90107, DATED JAN. 1959). THE OPERATIONAL CONDITION OF THE GATES IS UNKNOWN; IT WILL BE ASSUMED, HOWEVER, THAT THE DIVERSION CAN BE CONTROLLED AND THEREFORE, IT WILL NOT BE CONSIDERED IN THE ANALYSIS.

*AS REPORTED BY THE NEW HAVEN WATER CO. TO C.E. (G. STEVENS) ON 6/19/79

MALTBY LAKE DAM #1

1,b - Cont'd) MAXIMUM PROBABLE FLOOD - WATERSHED AREA

MALTBY LAKE #1 IS CROSSED BY THE STATE RTE #34 WHICH SEPARATES TWO RELATIVELY SMALL PORTIONS OF THE RESERVOIR TOWARDS THE RIGHT OF THE DAM (SOUTH-WEST END). THE INTERCONNECTION BETWEEN THE SEPARATED AND THE MAIN PORTION OF THE RESERVOIR UNDER THE HIGHWAY IS THROUGH 24" PIPE CULVERTS. THEREFORE, FLOW BETWEEN THESE SECTIONS IS RELATIVELY SMALL. FOR THE PURPOSE OF THESE ANALYSIS, THE HIGHWAY, A MAN MADE STRUCTURE, WILL NOT BE CONSIDERED AS REGULATING THE FLOW.

IT IS ALSO NOTED THAT A PARTIAL DIVERSION FROM A RELATIVELY FLAT SWAMPY AREA AT THE HEADWATERS OF THE COVE RIVER ALLOWS TO CERTAIN EXTENT BOTH INFLOW AND OUTFLOW TO AND FROM THE LAKE VIA THE LARGEST OF THE TWO PORTIONS SEPARATED BY RTE #34. BECAUSE OF THE EXPECTED NEGLIGIBLE CONTRIBUTION TO THE PMF FROM THIS DIVERSION, THE ADDITIONAL WATERSHED (UNDEFINED) WILL BE ASSUMED NON-EFFECTIVE

FURTHER, THE POTENTIAL OF THIS CONNECTION AS AN AUXILIARY (EMERGENCY) OVERFLOW, ADDITIONAL SURCHARGE STORAGE CAPACITY, OR ANY OTHER EFFECT THAT THE SEPARATED PORTION OF THE RESERVOIR AND/OR DIVERSION MAY HAVE UPON THE PMF, SDF OR PEAK OUTFLOW AND SURCHARGE WILL NOT BE DIRECTLY CONSIDERED IN THE ANALYSIS. THE ONLY SIGNIFICANT EFFECT THAT RTE 34 MAY HAVE UPON THE SURCHARGE AND THAT WILL BE INCLUDED IN THE ANALYSIS IS IF OVERTOPPED. THIS OVERFLOW WHICH PRACTICALLY WILL NOT RETURN TO THE LAKE WILL BE ASSUMED TO DRAIN TO COVE RIVER.

MALTBY LAKE DAM #1

1.6 - Cont'd) MAXIMUM PROBABLE FLOOD - WATERSHED AREA

i) TOTAL *D.A. ≅ 1.29 sq.mi (W/O WEHAWAKA & TROUT BR. DIV. OF 8.6 sq mi) (USGS HARTFORD & N.H.W.CO.)

ii) D.A. U/S FROM MALTBY LAKE #2: *D.A. ≅ 0.69 sq mi (CE)

iii) D.A. U/S FROM MALTBY LAKE #3: *D.A. ≅ 0.31 sq mi (CE)

iv) DIRECT DA. TO MALTBY LAKE #1: *D.A. ≅ 0.29 sq mi (SEE P. 2 OF THESE CALCS)

*NOTE: DATA FROM U.S.G.S. HARTFORD OFFICE: DA = 1.29 sq mi; CE CHECK MEASURE: $(D.A.)_{TOT.} \cong 1.25$ sq mi; MALTBY #1: $(DA)_1 \cong 0.25$ sq mi; $(DA)_2 \cong 0.31$ sq mi; $(DA)_3 \cong 0.69$ sq mi; NEW HAVEN WATER CO. DATA SHEET (INVENTORY) SHOWS $(DA)_{TOT} = 1.2$ sq mi $(DA)_3 = 0.6$ sq mi; $(DA)_2 = 0.3$ sq mi; $(DA)_1 \cong 0.3$ sq mi

c) FROM NED-ACE "PRELIMINARY GUIDANCE FOR ESTIMATING MAX. PROBABLE DISCHARGES". GUIDE CURVES FOR PMF - PEAK FLOW RATES EXTRAPOLATION TO DA's ≅ 2.0 sq mi:

$$PMF \cong 2250 \text{ cfs/sq mi}$$

d) PEAK INFLOW: $PMF \cong 2250 \times 1.29 \cong \underline{2900}$ cfs (TOTAL D.A.)

ACTUALLY, THE PEAK INFLOW TO MALTBY DAM #1 IS REGULATED BY MALTBY DAMS #2 & #3 WHICH DRAIN INTO IT. APPROXIMATE ROUTING OF THE PMF AND ½ PMF PEAK INFLOWS TO THESE RESERVOIRS HAS DEMONSTRATED THAT THE REDUCTION OF THE PEAK INFLOW TO MALTBY LAKE #1 BECAUSE OF THE U/S RESERVOIRS REGULATION IS RELATIVELY SMALL (PMF RED. FROM 2900 cfs TO (±) 2550 cfs AND ½ PMF FROM 1450 cfs TO (±) 1130 cfs) AND THEREFORE, IT WILL NOT BE CONSIDERED IN THIS ANALYSIS.

MALTBY LAKE DAM #1

2) SPILLWAY DESIGN FLOOD (SDF)

a) CLASSIFICATION OF DAM ACCORDING TO NED-ACE RECOMMENDED GUIDELINES:

c) SIZE: STORAGE (MAX) $\doteq$ 260 AC-FT ($50 < S < 1000$ ACFT)
HEIGHT $\doteq$ 26' ($25 < H < 40$ FT)

STORAGE: FROM NEW HAVEN WATER CO. STORAGE VS. DEPTH BELOW SPILLWAY AND ELEVATION CURVE: STORAGE TO SPILLWAY CREST $S = 52.5$ MG $\doteq 161$ ACFT
ALSO, STORAGE TO LOWEST OUTLET FROM N.H.W.CO. DATA SHEET DATED AUG. 1929
USABLE STORAGE: $S_U \doteq 51$ MG. FROM SAME REFERENCE: LAKE AREA AT FLOW LINE: $A = 22.9$ AC. ∴ ASSUME AVG. AREA WITHIN EXPECTED SURCHARGE $\bar{A} \doteq 25$ AC ∴ SURCHARGE STORAGE FROM SPILLWAY CREST ELEV.* 133.3' MSL (130' MHW) TO TOP OF DAM ELEV.* 137.3' MSL (134' MHW): $\Delta S = 100$ ACFT.
∴ MAX. STORAGE: $S_{MAX} \doteq 160 + 100 \doteq 260$ ACFT. (SEE P.2 OF THESE CALCS)

HEIGHT: FROM SAME DATA SOURCES AS FOR STORAGE. NATURAL STREAM BED ELEV. (±) 111.3' MSL (108' MHW).

(c) HAZARD POTENTIAL: MALTBY LAKE DAM #1 IS LOCATED IMMEDIATELY U/S FROM RTE #34 AND THE URBANIZED SECTION OF WEST HAVEN NEAR MORRIS AVE., HILLSIDE ST., WINFIELD ST. AND FOREST HILLS RD. WHICH WILL BE DIRECTLY AFFECTED UPON FAILURE OF THE DAM.

*NOTE: ELEVATIONS GIVEN IN NEW HAVEN WATER CO. DATA ARE NEW HAVEN DATUM (MHW)
USCGS DATUM (MSL) = NEW HAVEN DATUM (MHW) + 3.31'
(USE +3.3')

MALTBY LAKE DAM #1

2.a.-Cont'd) CLASSIFICATION OF DAM ACCORDING TO NED-ACE GUIDELINES.

iii) CLASSIFICATION:

SIZE: SMALL

HAZARD: HIGH

b) SDF = PMF = 2900 CFS ½ PMF = 1450 CFS

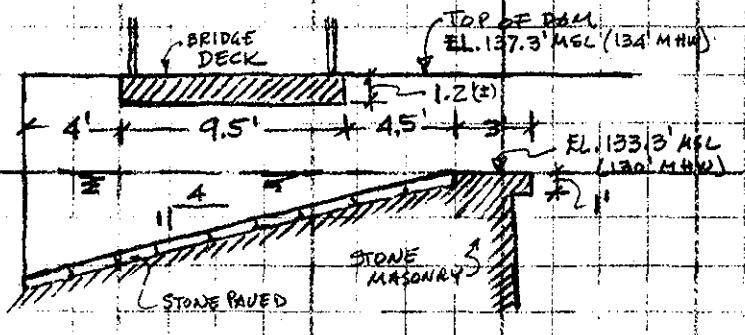
3) SURCHARGE AT PEAK INFLOWS

a) PEAK INFLOW: Q_{P_1} = 2900 CFS Q'_{P_1} = ½ PMF = 1450 CFS

b) SPILLWAY (OUTFLOW) RATING CURVE

i) SPILLWAY:

MALTBY LAKE DAM #1 SPILLWAY IS CLASSIFIED AS A BROAD-CRESTED WEIR OF TRAPEZOIDAL CROSS SECTION WITH U/S INCLINED FACE (CONCRETE & STONE PAVED) ON (±) 4H TO 1V SLOPE. THE CREST IS 3' BROAD AND (±) 21.5' LONG. THE CENTRAL (±) 15.5' OF THE SPILLWAY CREST ARE AT ELEV. 133.3' MSL (130' MHW) THE REMAINDER 3' AT EACH SIDE RAISE 0.5' TO (±) ELEV. 133.8' MSL AT THE SIDE WALLS. THE FLOORING U/S



PORTION OF THE WEIR IS CROSSED OVER BY A BRIDGE WITH PIPE RAILINGS. THE DECK, SUPPORTED BY 4 I-BEAMS IS (±) 1.2' THICK.

MACTAY LAKE DAM #1

3.6-Cont'd) OUTFLOW RATING CURVE

THE SPILLWAY DISCHARGES INTO A CHANNEL & CULVERT SYSTEM WHICH CARRIES THE FLOW FIRST, PARALLEL AND LATER, ACROSS RTE 34. THE CHANNEL AND CULVERT HEADWALL ARE LOW WITH RESPECT TO THE SPILLWAY CREST AND THEREFORE WILL NOT INTERFERE WITH THE SPILLWAY DISCHARGE, EVEN IF THEIR CAPACITY IS EXCEEDED. (DATA FROM N.H.W.Co. DRAWINGS AND C.E. FIELD SURVEY AND OBSERVATIONS).

∴ ASSUME A SPILLWAY DISCHARGE COEFFICIENT C=3.0. IT IS CONSIDERED THAT THIS COEFFICIENT ACCOUNTS FOR THE INTERFERENCE THAT THE BRIDGE DECK/RAILING MAY OFFER TO THE FLOW.

USING THE CREST ELEVATION AS DATUM (ELEV. 133.3' MSL), THE SPILLWAY DISCHARGE IS APPROXIMATED BY:

$$Q_S = 65 H^{3/2}$$

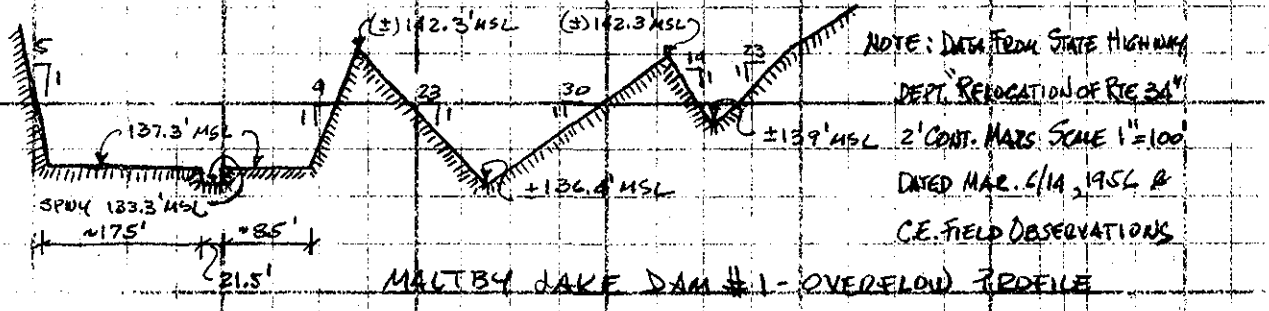
ii) EXTENSION OF RATING CURVES FOR SURCHARGE HEADS ABOVE TOP OF DAM.

THE DAM IS A GRAVITY MASONRY DAM AND U/S EARTH EMBANKMENT. THE TOP WIDTH OF THE COMBINED SECTION VARIES FROM (±) 26' TO (±) 36'; THE TOP WIDTH OF THE MASONRY SECTION ALONE IS 8' AND IS CAPPED BY A 3' WIDE, 15" THICK STONE LEDGE AND EARTH FILL. THE U/S SLOPE OF THE EARTH EMBANKMENT IS (±) 1.5" TO 1' AND THE D/S FACE OF THE MASONRY WALL IS ON (±) 1" TO 4' SLOPE. TO THE RIGHT OF THE SPILLWAY A MASONRY WING WALL EXTENDS U/S FOR (±) 85'. THE DAM, EXCLUDING THE SPILLWAY IS (±) 160' TOP ELEV.

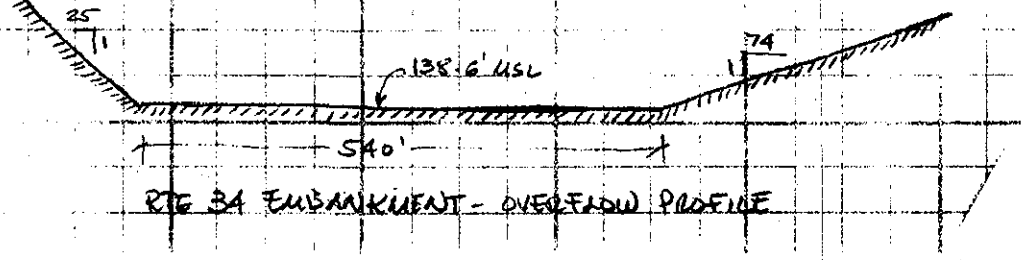
MALTBY LAKE DAM #1

3.6 - Cont'd) OUTFLOW RATING CURVE

OF DAM AND WING WALL IS (±) 137.3' MSL (134' MHW). THE TOTAL HORIZONTAL LENGTH AT THIS ELEVATION IS (±) 260' AND THE TERRAIN TO THE LEFT OF THE DAM RISES (±) IN A 5' H TO 1' V SLOPE. TO THE RIGHT OF THE WINGWALL THE TERRAIN RISES AND FALLS FORMING A SERIES OF SWALES, TWO OF WHICH MAY BE SUFFICIENTLY LOW SO AS TO ALLOW AT EXPECTED SURCHARGES, SOME OVERFLOW. (SEE SKETCH OF OVERFLOW PROFILE BELOW). FURTHER, APPROX. 540' OF THE RTE 34 EMBANKMENT THAT CROSSES THE LAKE WILL BE OVERTOPPED AT W.L. HIGHER THAN (±) W.S. ELEV. 138.6' MSL (135.3' MHW). ALTHOUGH, IN GENERAL, THE EFFECT OF RTE 34 ON THE PERFORMANCE OF THE DAM AT TEST FLOOD CONDITIONS WILL NOT BE STUDIED, THE OVERTOPPING OF THIS PORTION OF ROAD IS ASSUMED TO BE AN IMPORTANT OUTFLOW OF THE RESERVOIR ABOVE EL. 138.6' MSL WHICH WILL DRAIN TO COVE RIVER D/S FROM THE DAM AND THEREFORE, IT WILL BE INCLUDED IN THE OUTFLOW RATING CURVE. THE SIDE SLOPES OF THE DAM,



MALTBY LAKE DAM #1 - OVERFLOW PROFILE



RTE 34 EMBANKMENT - OVERFLOW PROFILE

MALTBY LAKE DAM #1

3.b-(Cont'd) OUTFLOW RATING CURVE

THE ROAD AND SWALES ARE MOSTLY WOODED MAINLY WITH EVER-GREENS.

ASSUME $C=3.0$ FOR THE OVERFLOW AT THE DAM AND WING WALL.
$C=2.7$ FOR THE OVERFLOW AT THE HIGHWAY
$C=2.5$ FOR THE WOODED TERRAIN.

ASSUME ALSO, EQUIVALENT LENGTHS FOR THE SLOPING TERRAIN AT THE SIDES OF THE DAM, SWALES AND HIGHWAY, THE FOLLOWING FORMULAS ARE DEVELOPED TO APPROXIMATE THE OVERFLOW (SEE PROFILE SKETCH ON PREVIOUS PAGE):

1') TOP OF DAM/WINGWALL: $L_1 = 260'$ $\therefore$ $Q_1 = 780\,(H-4)^{3/2}$

2') LEFT AND RIGHT SIDES OF DAM/WINGWALL:

$$(L'_{L,R})_1 = \frac{2}{3}(5+9)(H-4) = 9.33(H-4) \quad \therefore \quad (Q'_{L,R})_1 = \frac{23\,(H-4)^{5/2}}{\text{FOR } H \le 9'}$$

3') LEFT AND RIGHT SIDES OF LOW SWALE:

$$(L'_{L,R})_2 = \frac{2}{3}(23+30)(H-3.1) = 35.3(H-3.1) \quad \therefore \quad (Q'_{L,R})_2 = \frac{88\,(H-3.1)^{5/2}}{\text{FOR } H \le 9'}$$

4') LEFT AND RIGHT SIDES OF HIGHER SWALE:

$$(L'_{L,R})_3 = \frac{2}{3}(14+23)(H-5.7) = 24.7(H-5.7) \quad \therefore \quad (Q'_{L,R})_3 = \frac{62\,(H-5.7)^{5/2}}{\text{FOR } H \le 9'}$$

MACTAQUAC LAKE DAM #1

3.6, ii-Cont'd) OUTFLOW RATING CURVE

5') RTE 34 LOW GRADE SECTION AT (±) EL. 138.6' MSL

$L_{RD} = 540'$ ∴ $Q_{RD} = 1550\,(H-5.3)^{3/2}$

6') LEFT AND RIGHT SIDES OF RTE 34 LOW GRADE

$(L'_{L,e})_4 = \frac{2}{3}(25+74)(H-5.3) = 66\,(H-5.3)$ ∴ $(Q'_{L,e})_4 = 165\,(H-5.3)^{5/4}$ FOR $H \leq 11.7'$

THEREFORE THE TOTAL OVERFLOW RATING CURVE CAN BE APPROXIMATED BY:

$Q_T = Q_S + Q_D + (Q'_{L,e})_1 + (Q'_{L,e})_2 + (Q'_{L,e})_3 + Q_{RD} + (Q'_{L,e})_4$ FOR $H \leq 9'$

THE RESULTING OUTFLOW RATING CURVE IS PLOTTED ON NEXT PAGE.

c) SPILLWAY CAPACITY

IT SHOULD BE NOTED THAT THE SWALE CLOSEST TO THE RIGHT OF THE DAM IS AT ITS LOW POINT (±) EL. 136.4' MSL LOWER THAN THE DAM. THEREFORE, UNLESS IT IS RAISED TO AT LEAST ELEV. 137.8' MSL, THERE WILL BE SOME OVERFLOW BEFORE THE TOP OF THE DAM IS REACHED.

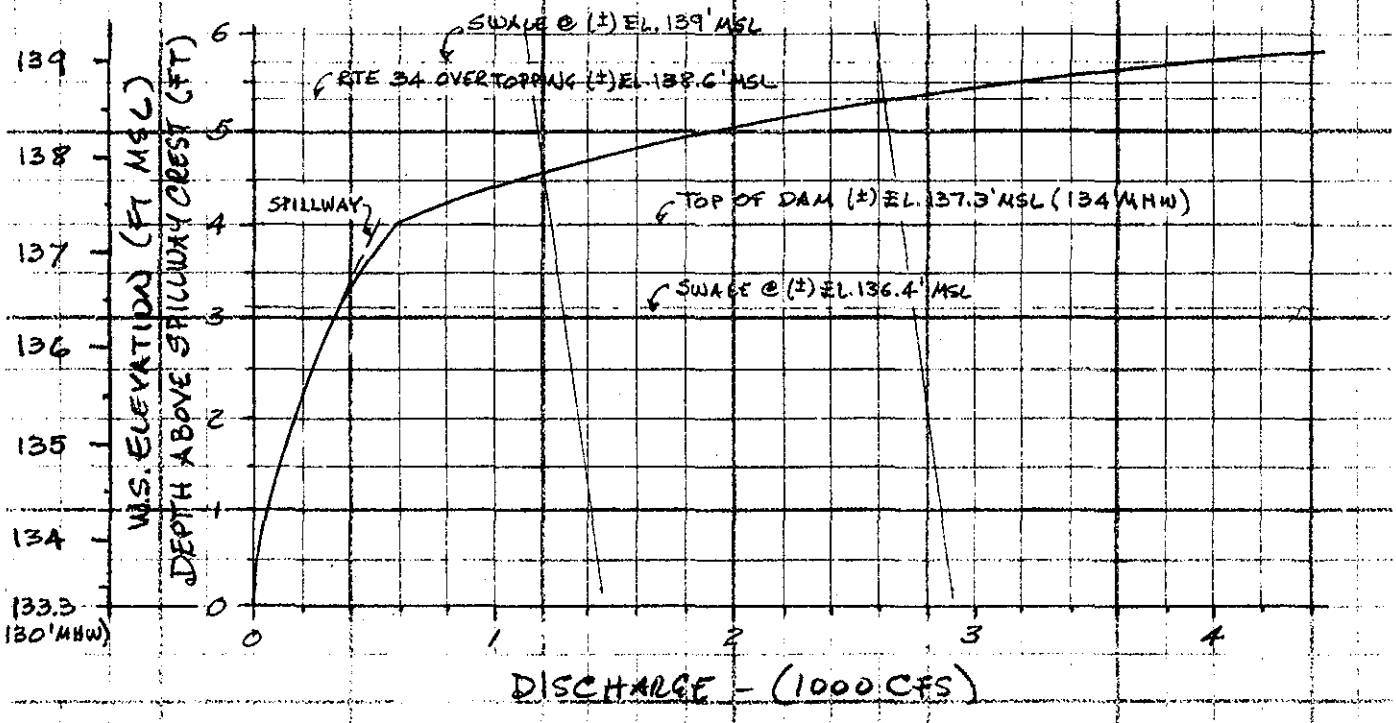
THE SPILLWAY CAPACITY IS THEN:

i) TO THE SWALE LOW POINT ELEV. 136.4' MSL

$H = 3.1'$ ∴ $Q_S = 350$ CFS (±) 12% OF Q_P; (±) 24% OF Q'_P)

MACTBY LAKE DAM #1

3. Cont'd) OUTFLOW RATING CURVE



● SEE NOTE p. 4 OF THESE COMPUTATIONS

C-Cont'd) SPILLWAY CAPACITY

ii) TO TOP OF DAM (ASSUMING NO LOW SWALE OVERFLOW):

$H = 4'$ ∴ $Q_s'' = 520$ CFS ((±) 18 % of Q_p ; (±) 36 % of Q_p')

*SEE p. 6 OF THESE COMPS.

iii) TO TOP OF DAM INCLUDING SWALE OVERFLOW:

$H = 4'$ ∴ $Q_s''' = 590$ CFS ((±) 20 % of Q_p ; (±) 41 % of Q_p')

MALTBY LAKE DAM #1

3-Cont'd) SURCHARGE AT PEAK INFLOWS:

d) SURCHARGE HEIGH TO PASS Q_{p_1}:

i) @ Q_{p_1} = PMF = 2900 CFS $H_1 \cong 5.4'$

ii) @ $Q_{p_1}' = \frac{1}{2}$ PMF = 1450 CFS $H_1' \cong 4.7'$

4) EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES (OUTFLOW)

a) RESERVOIR (LAKE) AREA @ FLOW LINE: * A = 22.9 AC

∴ ASSUME AVE. LAKE AREA WITHIN EXPECTED SURCHARGE, * $\bar{A} \cong 25$ AC

*SEE "STORAGE" ON P.4 OF THESE COMPUTATIONS. NO SUBSTANTIAL AREA/STORAGE INCREMENT FROM THE LAKE PORTIONS SEPARATED BY THE ROAD IS CONSIDERED.

b) ASSUME NORMAL POOL LEVEL (±) 0.2' ABOVE SPILLWAY CREST (EL 1335.4')

c) WATERSHED AREA: DA = 1.29 SQ MI (See p. 3 OF THESE COMPS.)

d) DISCHARGE (Q_{p_2}) AT VARIOUS HYPOTHETICAL SURCHARGE ELEVATIONS:

H = 6' V = 25 x (6 - 0.2) = 145 AC-FT ∴ $S = \frac{145}{1.29 \times 53.3} = 2.11"$

H = 3' V = 70 AC-FT ∴ S = 1.02"

MACTAY LAKE DAM #1

A,1-Cont'd) EFFECT OF SURCHARGE ON PEAK OUTFLOW - (Q_{p_2})

∴ FROM APPROXIMATE STORAGE ROUTING NED-ACE GUIDELINES (19" MAX. PROBABLE R.O. IN NEW ENGLAND):

$Q_{p_2} = Q_{p_1}\left(1 - \frac{S}{19}\right)$ AND FOR ½ PMF: $Q'_{p_2} = Q'_{p_1}\left(1 - \frac{S}{9.5}\right)$

∴ FOR THE PREVIOUS HYPOTHETICAL DISCHARGES:

$H = 6'$ $Q_{p_2} = 2580^{CFS}$ $Q'_{p_2} = 1130^{CFS}$

$H = 3'$ $Q_{p_2} = 2750^{CFS}$ $Q'_{p_2} = 1300^{CFS}$

ALSO, FOR $H = 0.2$; $Q_{p_2} = 2900^{CFS}$ AND $Q'_{p_2} = 1450^{CFS}$

e) PEAK OUTFLOW (Q_{p_3}).

USING NED-ACE GUIDELINES "SURCHARGE STORAGE ROUTING" ALTERNATE METHOD (See p. 10 OF THESE COMPUTATIONS):

$Q_{p_3} = 2620^{CFS}$ $H_3 = 5.3'$ FOR Q_p = PMF

$Q'_{p_3} = 1220^{CFS}$ $H'_3 = 4.6'$ FOR Q'_p = ½ PMF

f) SPILLWAY CAPACITY RATIO TO OUTFLOW:

i) SPILLWAY CAPACITY* TO THE SURGE LOW POINT: $Q'_s = 350^{CFS}$

∴ THE SPILLWAY CAPACITY IS (+)13% THE OUTFLOW AT PMF (TEST FLOOD) AND (+)29% THE OUTFLOW AT ½ PMF.

*See pp. 9 & 10 OF THESE COMPUTATIONS

MACTBY LAKE DAM #1

4, f - Cont'd) EFFECT OF SURCHARGE ON PEAK OUTFLOW - SPWY CAP. AT Q_{P_3}

ii) SPILLWAY CAPACITY TO TOP OF DAM (ASSUMING NO SWALE OVERFLOW)
IF THE LOW POINT AT THE RIGHT OF THE DAM IS CLOSED, THERE WILL BE A SLIGHT (NEGLIGIBLE) INCREASE IN SURCHARGE AND A CONSEQUENT NEGLIGIBLE REDUCTION IN Q_{P_3} AND Q'_{P_3}. THE SPILLWAY CAPACITY TO TOP OF THE DAM WOULD BE: $Q_{S_{ii}} = 520$ CFS OR, (±) 20% THE OUTFLOW AT PMF AND (±) 43% THE OUTFLOW AT ½ PMF

iii) SPILLWAY CAPACITY TO TOP OF DAM INCLUDING THE SWALE OVERFLOW:
$Q_{S_{iii}} = 590$ CFS OR, (±) 23% THE OUTFLOW AT PMF AND (±) 48% THE OUTFLOW AT ½ PMF

5) SUMMARY

a) PEAK INFLOW: $Q_{P_1} = PMF = 2900$ CFS $\quad Q'_{P_1} = ½ PMF = 1450$ CFS

b) PEAK OUTFLOW: $Q_{P_3} = 2620$ CFS $\quad Q'_{P_3} = 1220$ CFS

c) SPILLWAY CAPACITY TO FIRST POINT OF OVERFLOW (SWALE): $Q_{S_{ii}} = 350$ CFS OR, (±) 13% OF Q_{P_3} AND (±) 29% OF Q'_{P_3} (See 4, f p.13 AND ABOVE)

THEREFORE AT SDF = PMF THE DAM IS OVERTOPPED (±) 1.3' (W.S. EL 138.6' MSL = 135.3' MHW) OR, TO A SURCHARGE OF (±) 5.3' ABOVE THE SPILLWAY CREST. AT THIS CONDITION, THE OVERFLOW AT THE LOW SWALE IS (±) 630 CFS AND (±) 2.2' DEEP.

AT TEST FLOOD Q'_{P_3} = ½ PMF THE DAM IS OVERTOPPED (±) 0.6' (W.S. EL. 132.9' MSL = 134.6' MHW) OR TO A SURCHARGE OF (±) 4.6' ABOVE THE SPILLWAY CREST; THE SWALE OVERFLOW IS (±) 240 CFS AT A DEPTH OF (±) 1.5'

MACTBY LAKE DAM #1

II) DOWNSTREAM FAILURE HAZARD

1) PEAK FLOOD AND STAGE IMMEDIATELY D/S FROM DAM:

a) BREACH WIDTH:

i) MID-HEIGHT (±) ELEV. 124.3' MSL (121' MHW) $(137.3 - \frac{26}{2} = 124.3'\ MSL)$

* SEE "HEIGHT" P. 4 OF THESE COMPS.

ii) APPROX. MID-HEIGHT LENGTH: $L_b = 160'$ (±) C.E. MEASURE ON N.H.W.C.B. DWG. No. 30007 AND HWY DEPT. 1"=100' MAP, 3/52)

iii) BREACH WIDTH (SEE NED-ACE D/S DAM FAILURE GUIDELINES):

$W = 0.4 \times 160 = 64'$ ∴ ASSUME $W_b \approx 60'$

b) PEAK FAILURE OUTFLOW (Q_{P_1}):

ASSUME SURCHARGE TO TOP OF DAM (EL. 137.3' MSL); THEREFORE,

i) HEIGHT AT TIME OF FAILURE: $Y_o = 26'$

ii) SPILLWAY DISCHARGE: $Q_s \approx 520$ CFS (SEE P. 10 OF THESE COMPS.)

iii) BREACH OUTFLOW (Q_b):

$$Q_b = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2} = 13400 \text{ CFS}$$

iv) PEAK FAILURE OUTFLOW (Q_{P_1}): $Q_{P_1} = Q_s + Q_b \approx \underline{13900}$ CFS

c) FLOOD DEPTH IMMEDIATELY D/S FROM DAM:

$Y \approx 0.44 Y_o \approx \underline{11'}$

MACTBY LAKE DAM #1

1-Cont'd) PEAK FLOOD AND STAGE IMMEDIATELY D/S FROM DAM

d) APPROXIMATE STAGE JUST BEFORE FAILURE

i) $Q = Q_s = 520$ CFS

ii) CHANNEL D/S FROM DAM:

THE SPILLWAY DISCHARGE IS CONVEYED D/S BY A CULVERT OF VARIED CROSS-SECTION UNDER RTE 34. ESSENTIALLY THE CULVERT HAS 3 REACHES: a') $L \doteq 119'$, 10'W x 5'H Box; b') $L \doteq 50'$, 10' BASE x 5.5'H ARCH; AND $L \doteq 205'$, 8'W x 5'H Box. THE GROUND ELEV. @ HEADWALL IS (±) EL. 118' MSL; THE INVERT ELEV. AT THE OUTLET IS AT ELEV. 100.6' MSL. ASSUMING $n = 0.015$, THE CONVEYANCES OF THE 3 SECTIONS ARE RESPECTIVELY, $K_a' \doteq 2000$ $K_b' \doteq 6300$; $K_c' \doteq 5300$. THEREFORE, ASSUMING THE TAILWATER AT EL. 106' MSL (± TOP OF CULVERT) AND ENTRANCE ($K_e = 0.5$) OUTLET ($K_o = 1$) AND TRANSITION LOSSES ($K_{Tr} = 0.3$) THE CULVERT CAPACITY CAN BE APPROXIMATED BY:

$$Q_c \doteq 210 (H + 12)^{0.5}$$

WHERE H (POSITIVE OR NEGATIVE) IS THE SURCHARGE ABOVE THE HEADWALL (GROUND EL. 118' MSL).

∴ FOR $H = 0$, $Q_c = 730$ CFS CULVERT CAPACITY W/O OVERFLOW

THEREFORE, THE CULVERT CAN CARRY THE SPILLWAY DISCHARGE ($Q_s \doteq 520$ CFS) WITH (±) 6' FREEBOARD. (CONDITION JUST BEFORE FAILURE).

MALTBY LAKE DAM #1

1-Cont'd) PEAK FLOOD AND STAGE IMMEDIATELY D/S FROM DAM

e) RAISE IN STAGE AFTER FAILURE

i) $Q = Q_p = 13900$ CFS

ii) FLOODWAY D/S FROM DAM:

THE GROUND ABOVE THE CULVERT (RTE 34 AND IMMEDIATE IMPACT AREA) FORMS A FLOODWAY REACH OF TRAPEZOIDAL CROSS SECTION, (±) 130' AT THE BASE AND 18" TO 1' AND 3" TO 1' SIDE SLOPES. THE GROUND SLOPE D/S AT (±) $S = 2.4\%$. ASSUMING $n = 0.025$, THE FLOW WILL DIVIDE (ROUGHLY) BETWEEN THE CULVERT, (±) 800 CFS, AND THE FLOODWAY, (±) 13100 CFS. ASSUMING THIS STEADY-STATE TO REPRESENT THE CONDITIONS AFTER THE DAM FAILURE, THE FLOOD DEPTH ABOVE GROUND WILL BE APPROXIMATELY, $y = 4'$

2) SUMMARY

a) PEAK FAILURE OUTFLOW: $Q_p = 13900$ CFS

b) FLOOD DEPTH IMMEDIATELY D/S FROM DAM: $y_o = 11'$

c) APPROX. FLOOD DEPTH ABOVE GROUND AFTER FAILURE AT IMMEDIATE IMPACT AREA: $y = 4'$

PRELIMINARY GUIDANCE

FOR ESTIMATING

MAXIMUM PROBABLE DISCHARGES

IN

PHASE I DAM SAFETY

INVESTIGATIONS

New England Division
Corps of Engineers

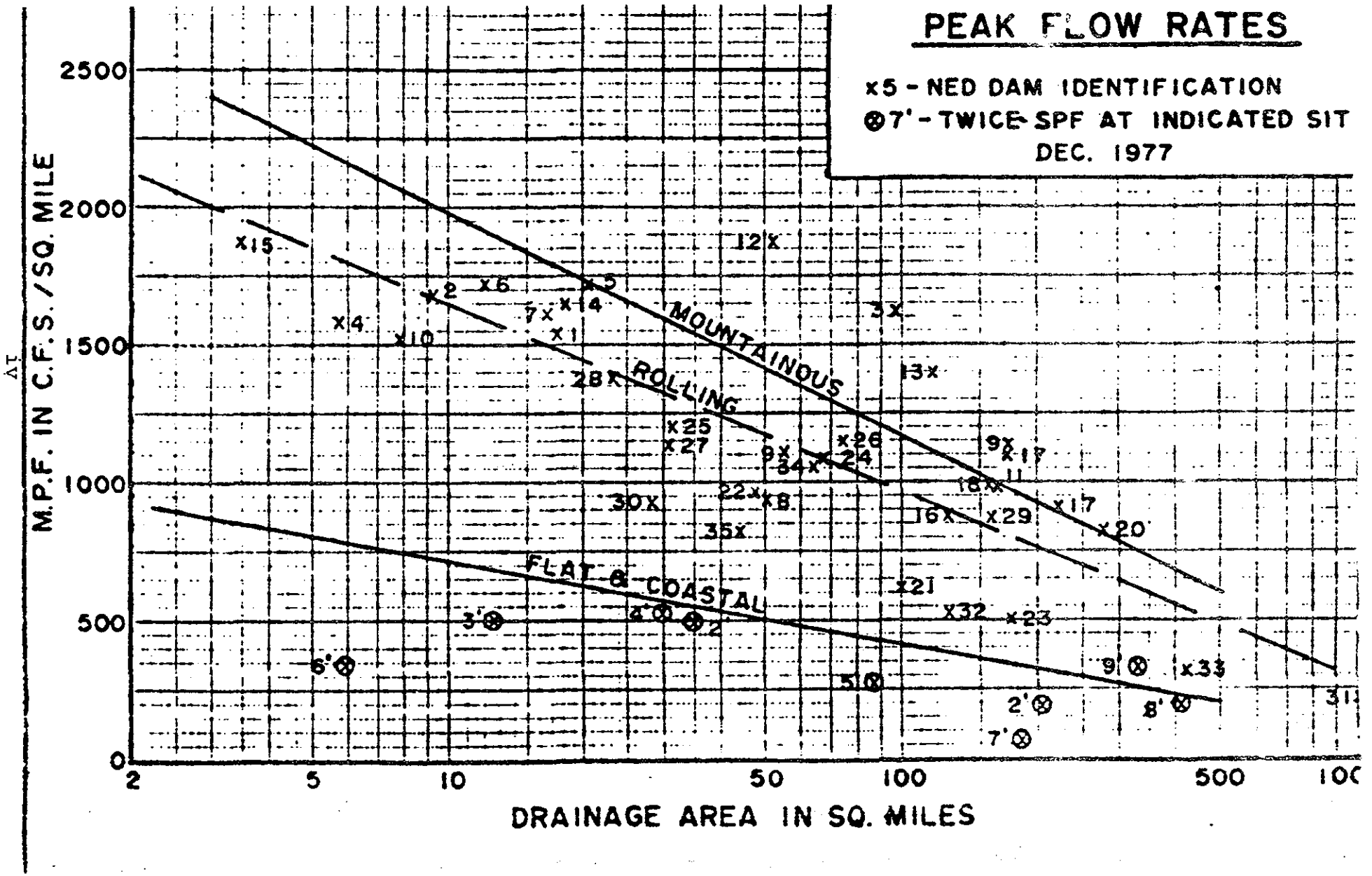
March 1978

MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

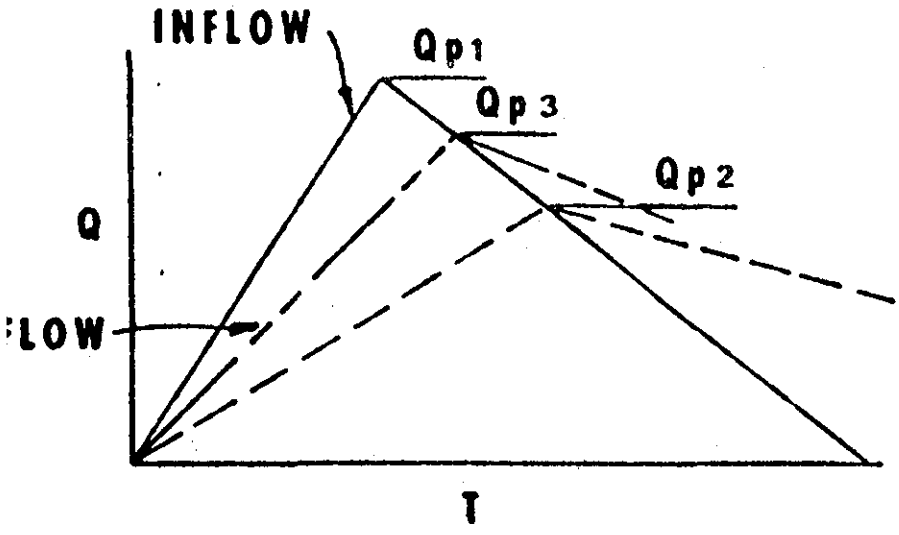
Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
Hall Meadow Brook	26,600	17.2	1,546
East Branch	15,500	9.25	1,675
Thomaston	158,000	97.2	1,625
Northfield Brook	9,000	5.7	1,580
Black Rock	35,000	20.4	1,715
Hancock Brook	20,700	12.0	1,725
Hop Brook	26,400	16.4	1,610
Tully	47,000	50.0	940
Barre Falls	61,000	55.0	1,109
Conant Brook	11,900	7.8	1,525
Knightville	160,000	162.0	987
Littleville	98,000	52.3	1,870
Colebrook River	165,000	118.0	1,400
Mad River	30,000	18.2	1,650
Sucker Brook	6,500	3.43	1,895
Union Village	110,000	126.0	873
North Hartland	199,000	220.0	904
North Springfield	157,000	158.0	994
Ball Mountain	190,000	172.0	1,105
Townshend	228,000	106.0(278 total)	820
Surry Mountain	63,000	100.0	630
Otter Brook	45,000	47.0	957
Birch Hill	88,500	175.0	505
East Brimfield	73,900	67.5	1,095
Westville	38,400	99.5(32 net)	1,200
West Thompson	85,000	173.5(74 net)	1,150
Hodges Village	35,600	31.1	1,145
Buffumville	36,500	26.5	1,377
Mansfield Hollow	125,000	159.0	786
West Hill	26,000	28.0	928
Franklin Falls	210,000	1000.0	210
Blackwater	66,500	128.0	520
Hopkinton	135,000	426.0	316
Everett	68,000	64.0	1,062
MacDowell	36,300	44.0	825

MAXIMUM PROBABLE FLOWS BASED ON TWICE THE STANDARD PROJECT FLOOD (Flat and Coastal Areas)

	River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1.	Pawtuxet River	19,000	200	190
2.	Mill River (R.I.)	8,500	34	500
3.	Peters River (R.I.)	3,200	13	490
4.	Kettle Brook	8,000	30	530
5.	Sudbury River.	11,700	86	270
6.	Indian Brook (Hopk.)	1,000	5.9	340
7.	Charles River.	6,000	184	65
8.	Blackstone River.	43,000	416	200
9.	Quinebaug River	55,000	331	330


PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SIT
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
MOUNTAINOUS
ROLLING
FLAT & COASTAL
2500
2000
1500
1000
500
0
2
5
10
50
100
500
x15
x4
x10
x2
x6
x5
7x
x14
x1
12x
3x
28x
13x
x25
x27
9x
x26
x24
34x
9x
x17
18x
x17
x20
16x
x29
30x
22x
x8
35x
x21
x32
x23
3'⊗
4'⊗
2
6'⊗
5⊗
9'⊗
x33
2'⊗
8'⊗
7'⊗

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Qp_1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp_1".

b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".

SURCHARGE STORAGE ROUTING SUPPLEMENT

TEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "Qp_3".

c. If Surcharge Height for Qp_3 and "$STOR_{AVG}$" agree O.K. If Not:

TEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "Qp_3"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "Qp_4"

c. Surcharge Height for Qp_4 and "New $STOR_{Avg}$" should Agree closely

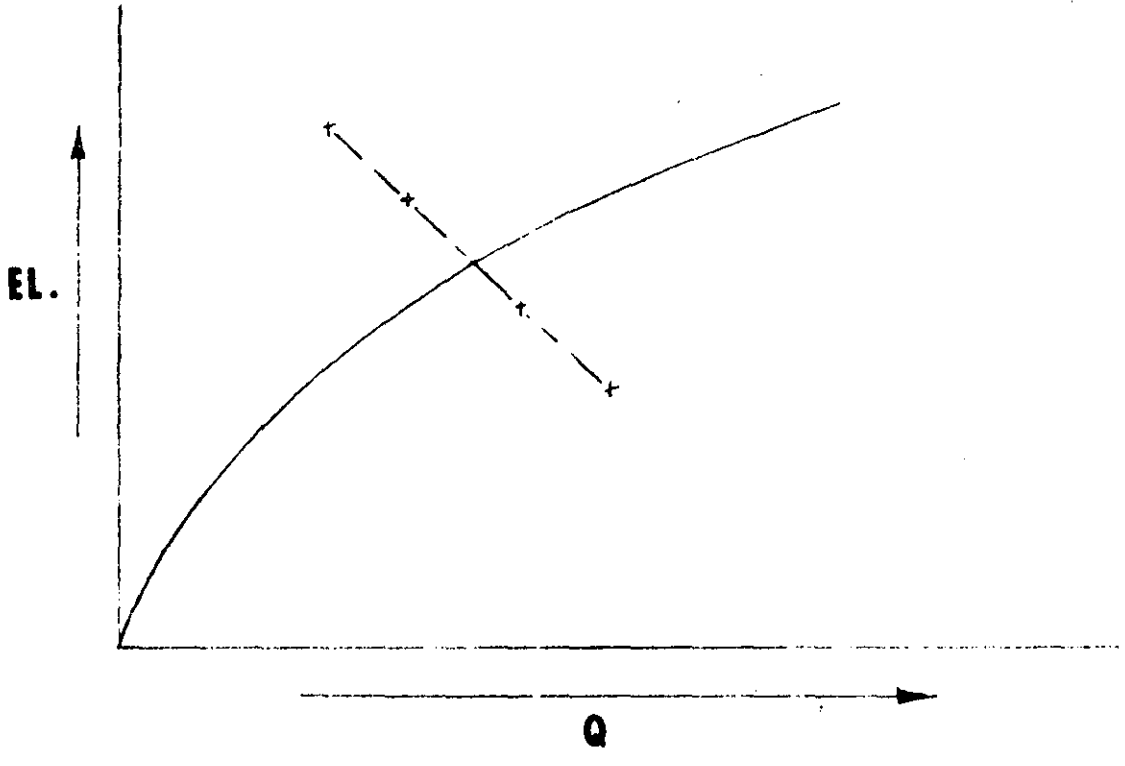
SURCHARGE STORAGE ROUTING ALTERNATE

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR}{19}\right)$$

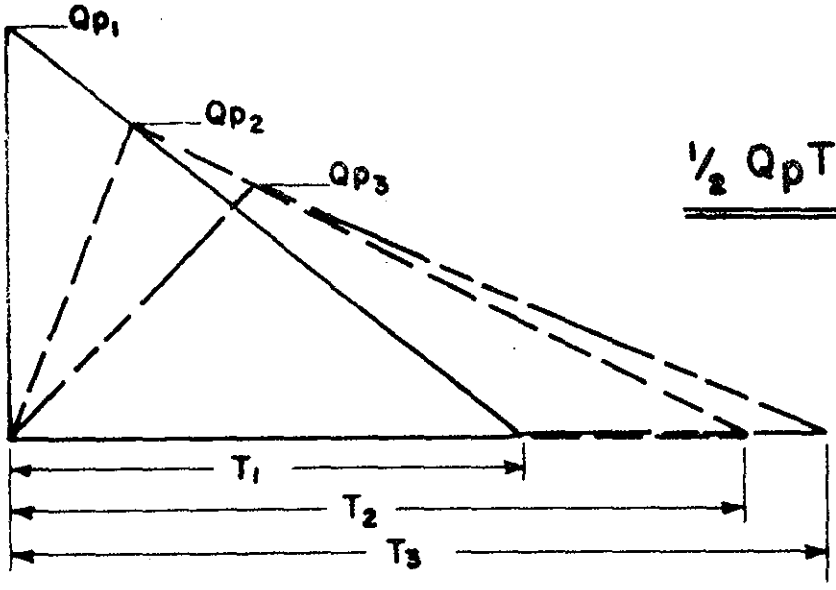
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

FOR KNOWN Q_{p1} AND 19'' R.O.

Q_{p2}	STOR	EL.



RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g} Y_o^{\frac{3}{2}}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(TRIAL) = Qp_1 \left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 \left(1 - \frac{V_{AVG}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
CT	111	NED	CT	009	03				MALTBY LAKE DAM NUMBER 1	4118.3	7258.3	31AUG79

(11) POPULAR NAME	(11) NAME OF IMPOUNDMENT
	MALTBY LOWER LAKE

(13) REGION	(18) BASIN	(17) RIVER OR STREAM	(14) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(15) DIST FROM DAM (MI.)	(20) POPULATION
01	07	TR-WEST RIVER	WEST HAVEN	3	53600

(17) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	(27) IMPOUNDING CAPACITIES NORMAL (ACRE–FT.)
REPG	1862	S	28	26	260	161

DIST OWN FED R PRV/FED SCS A VER/DATE
NED N N N N

(28) REMARKS
22-GRAVITY SECTION IN 1900

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
1	182	U	22	520												

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
NEW HAVEN WATER COMPANY	ALBERT B HILL	CHARLES W BLAKESLEE

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES

(53) INSPECTION BY	(54) INSPECTION DATE DAY | MO | YR	(55) AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	01MAY79	PL 92-367

(56) REMARKS